INTERNATIONAL CLINICS

A QUARTERLY

OF

CLINICAL LECTURES AND ESPECIALLY PREPARED ARTICLES

ON

MEDICINE, NEUROLOGY, SURGERY, THERAPEUTICS, OBSTETRICS, PÆDIATRICS, PATHOLOGY, DERMATOLOGY, DISEASES OF THE EYE, EAR, NOSE, AND THROAT, AND OTHER TOPICS OF INTEREST TO STUDENTS AND PRACTITIONERS

BY LEADING MEMBERS OF THE MEDICAL PROFESSION THROUGHOUT THE WORLD

EDITED BY

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CONTENTS OF VOLUME III.

(TENTH SERIES.)

SYMPOSIUM ON GENITO-URINARY DISEASES.

THERAPEUTICS.

MEDICINE.

NEUROLOGY.

SURGERY.

OBSTETRICS AND GYNÆCOLOGY.

DISEASES OF THE EYE AND EAR.

LABORATORY METHODS.

MONOGRAPH.

LIST OF ILLUSTRATIONS TO VOLUME III.

(TENTH SERIES.)

PLATES.

FIGURES.

Symposium on Genito-Urinary Diseases[1]

PART I.

ASEPTIC URETHRAL INSTRUMENTATION.[2]

BY FERDINAND C. VALENTINE, M.D.,

Professor of Genito-Urinary Diseases in the New York School of Clinical Medicine; Genito-Urinary Surgeon to the West Side German Dispensary; and Genito-Urinary Consultant to the United Hebrew Charities, to the Metropolitan Dispensary and Hospital, etc.

Our present knowledge shows that only approximate urethral asepsis is attainable; and being but approximate, it is not asepsis at all. The rapidity with which germs proliferate under the stimulus of even a slight irritation of their habitat makes the presence of a single pathogenic microbe a source of danger which the best-directed efforts can overcome but in part. Moreover, it is within reason to assume that the non-pathogenic bacteria of the healthy urethra may, in consequence of very slight irritation, assume a pathogenic character. Bacteria, whether normal or pathogenic, do not lie upon the surface of the mucosa, but penetrate the crypts, glands, follicles, and even the stroma of this membrane. Nevertheless all possible aseptic precautions should be observed.

Recognizing the probability of arousing the bacteria normally present in the urethra into noxious activity by instrumental ingression, we must appreciate the possibly greater danger of introducing

[1] The articles in this symposium were secured through the efforts of Dr. E. Franklin Smith, of New York City.

[2] Read by invitation before the second joint annual meeting of the Medical Societies of the Counties of Chemung, Ontario, Schuyler, Steuben, and Yates, held at Grove Springs, Lake Keuka, New York, August 14 and 15, 1900.

pathogenic bacteria into the canal. Separation of the walls of the male urethra by any agencies other than the urine or semen must be regarded as a surgical operation.

All surgical interventions demand asepsis. While the truth of this assertion is no longer questioned, it cannot be denied that dirty work sometimes proves successful. It would, however, be as illogical to use this fact as an argument against asepsis as to assert, because one boy falls from an apple-tree and is not injured, that apple-trees are a safe habitat for the whole human race. On the other hand, who has not seen rough and awkward operators attain remarkable success through scrupulous asepsis?

As in all aseptic surgical work, urethral ingressions imply as necessary conditions: 1. Surgically clean hands. 2. Surgically clean instruments. 3. As surgically clean a field of operation as is obtainable. 4. Such post-operative treatment as will effectively counteract the consequences of our inability to secure an absolutely sterile field of operation.

Surgically clean hands are unobtainable when a subungual space is allowed to remain. Essential to the practitioner's daily toilet are careful trimming and filing of the nails that leave no vestige of a subungual space, which, despite most arduous scrubbing and scraping, may yet remain a very hotbed for bacterial propagation. The little dermal elevations about the finger-tips, called "hang-nails," and the integumentary folds at the bases of the nails must also be trimmed, to offer no recesses for the proliferation of infectious material.

Many excellent treatises and monographs have been published on hand-disinfection. For practical purposes their gist may be summed up as follows:

1. With a *clean* nail-brush vigorously scrub the hands for three minutes with soap in running water as hot as can be borne.

2. Rub the hands with pledgets of sterile cotton soaked in ether.

3. Rinse the hands with alcohol.

4. Crush wet crystals or tablets of potassium permanganate with the hands, and rub the resulting moist powder into the skin until it is of a dark mahogany color.

5. Remove the permanganate stain by rubbing with crystals of oxalic acid in flowing hot water.

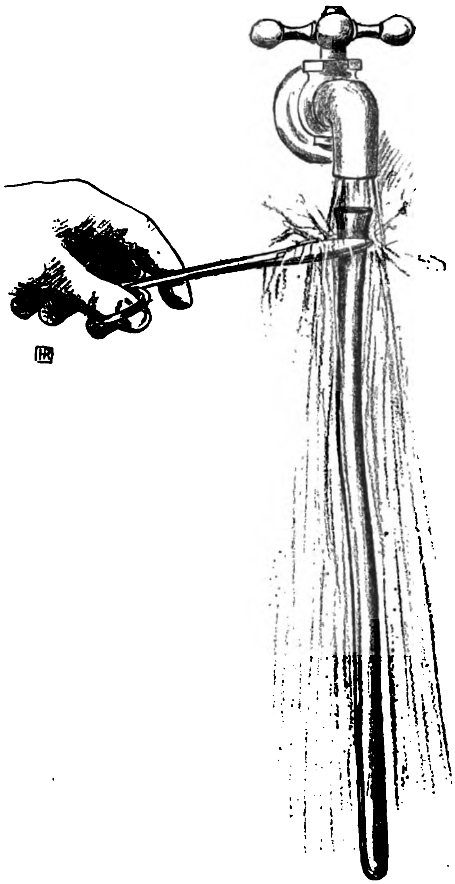
6. Rinse the hands with alcohol.

7. Rinse with sterile water.

These seven steps of hand-sterilization can be accomplished in about five minutes.

Surgically clean instruments are by no means beyond the reach of the general practitioner, although he should not be expected

FIG. 1.

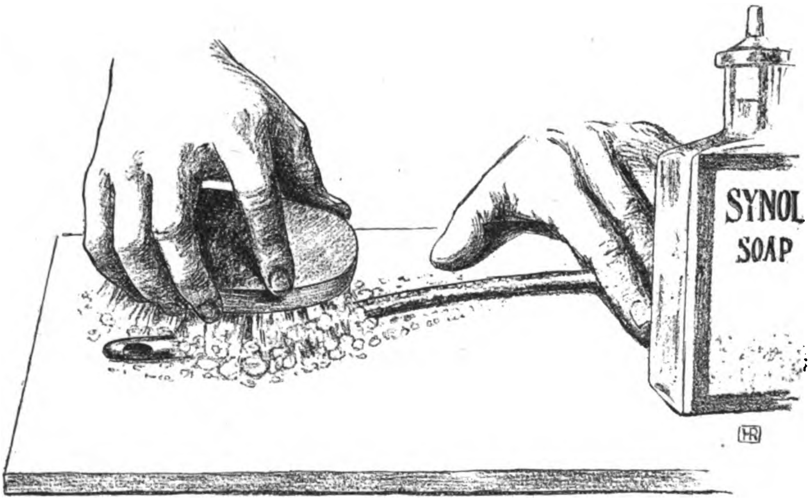


always to have at hand the appliances without which the specialist's office would be incomplete.

The only difficulty is with hollow instruments, such as catheters and the filiform attachments of instillators, whose inner surface cannot be reached by ordinary antiseptic applications. This applies

especially to flexible catheters, made of woven cotton, linen, or silk, permeated, covered, and lined with gum, and therefore not ordinarily amenable to sterilization by high degrees of heat such as metal instruments can bear without detriment. The better kinds of French and German catheters, as well as some American varieties, however, can be boiled several times. As mentioned, the difficulty with all hollow instruments, whether of metal or pliable material, is that the effect of heat upon their inner surface, especially when of very small calibre, is uncertain. Effective, but expensive and complicated, apparatus for forcing steam through these instruments are made. But the general practitioner, who must often

FIG. 2.



hasten over great distances to save life, often without being informed of the nature of the difficulty he is to encounter, cannot carry with him such a complete armamentarium as he would like. The difficulty of prompt sterilization of the interior of hollow instruments is overcome by the irrigator that I now have the pleasure of showing.

With a view to systematizing the sterilization of all urethral instruments, let us briefly go over the steps to be employed.

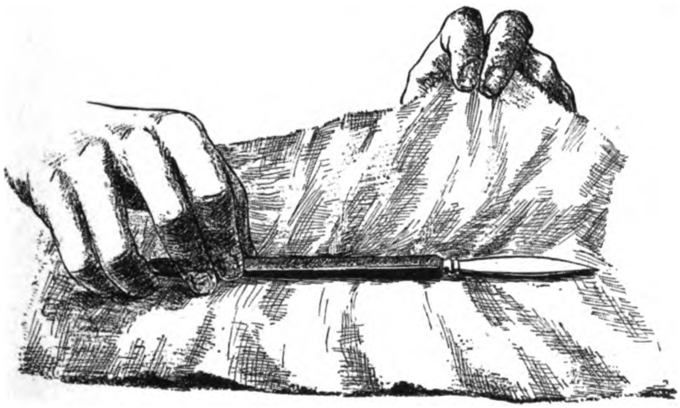
1. Immediately after use hold the entire instrument for three minutes under running boiling water. When boiling water from a

spigot is not available, it will be well to dip all instruments immediately after use in ether, and then to rub them with pledgets of cotton soaked in alcohol.

2. Scrub the instruments thoroughly for five minutes in boiling water with a clean brush, using aseptic soap. A liquid called synol (recently placed on the market) seems to serve admirably for this purpose. Besides being an effective and economical soap, it is a good lubricant as well.

3. Boil cutting instruments in a five per cent. solution of carbolic acid for five minutes; boil blunt metallic instruments for the same time in a solution of caustic soda.

FIG. 8.



4. Expose cutting and blunt metallic instruments for ten minutes to formalin vapor in a Schering sterilizer, a convenient and cheap apparatus for this purpose.

5. Keep each instrument wrapped in sterilized gauze until required. Goelet, in a paper read in June, 1900, before the American Medical Association, advocated dipping the sterilized instruments into synol, and allowing this substance to dry upon them before wrapping in gauze. An impermeable coating is thus obtained, which can be readily dissolved in hot water before the instruments are used.

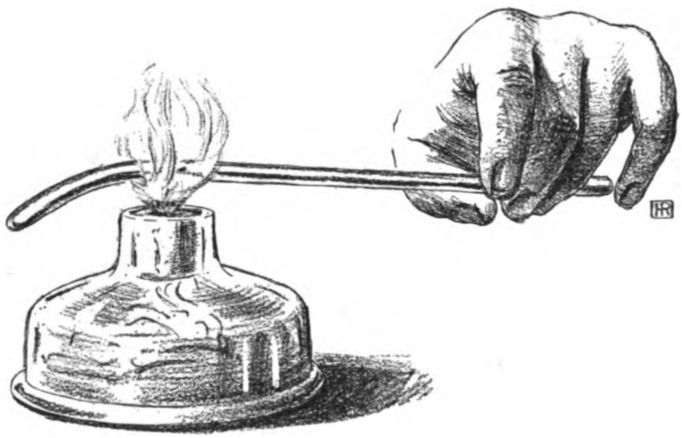
6. Before using an instrument so wrapped, and after washing it with boiling water, pass it through the flame of a Bunsen burner or of an alcohol lamp. In such emergencies as are perhaps more

likely to befall the general practitioner than the specialist, no Bunsen burner or alcohol lamp may be at hand. In such an event the instrument may be dipped in alcohol and the alcohol ignited. Care should be taken, after the alcohol has burned out, that the instrument has cooled sufficiently before inserting it into the urethra.

Solid and hollow flexible instruments, such as bougies and catheters, require somewhat different treatment, as do also metal catheters.

1. Immediately after use hold the instrument in running boiling water for three minutes; if it is a hollow instrument, be sure that

FIG. 4.



the boiling water runs through its inner as well as over its external surface.

2. Scrub the instrument with a clean brush, using soap or synol.

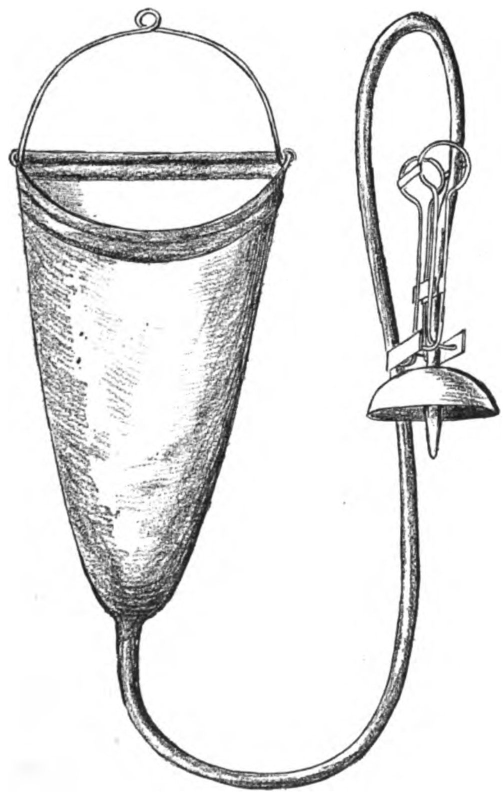
3. Beat up an ounce of synol with five ounces of boiling water, and place the resultant lather in the irrigator to be described later on. The soft conical nozzle of this irrigator will fit into any catheter, and the preparation just mentioned will cleanse the inner surface as thoroughly as is possible. Naturally, when the surgeon has a steam sterilizer for catheters, such as the one devised by E. R. W. Frank, of Berlin, a number of catheters can be sterilized at once.

4. Keep the cleansed soft instruments in a three per cent. solution of formalin in sterile glycerin until next required. Before use wash carefully, as the formalin-glycerin will otherwise burn the urethra severely.

Before discussing the preparation of the channel to be entered or traversed by an instrument it is necessary to say a few words about the auto-irrigator, which was originally devised for the treatment of gonorrhœa, but which admirably serves the purpose at present in view.

The use of the auto-irrigator was first publicly demonstrated by

Fig. 5.



me before the Genito-Urinary Section of the New York Academy of Medicine in March, 1900, and more fully described in a paper on "Surgical Asepsis of the Urethra and Bladder," read before the American Medical Association at its meeting in Atlantic City in June of this year.

The apparatus is made by the Miller Rubber Manufacturing

Company, of Akron, Ohio. It is compressible into such small dimensions that it occupies hardly any appreciable space in the instrument-bag, to whose weight it does not materially add. All its parts being sterilizable, it can be boiled in its entirety.

It consists of a rubber bag with a capacity of fifteen hundred cubic centimetres (about three pints). Attached to the bag is a rubber tube four and one-half feet long, terminating in a soft-rubber shield and nozzle. The nozzle is conical, and ends in a tip so soft that it cannot injure the most exquisitely inflamed meatus. The conical shape of the tip makes it easily insertible into any catheter, which can be entirely occluded by the tip for bladder-washings, such as are required in the cystitis of prostatitis. The

Fig. 6.

force of the stream from this auto-irrigator is very easily regulated by a simple spring stopcock.

Having briefly considered the instrument, whose simplicity of construction renders detailing the technique of its employment unnecessary to educated physicians, the following directions for obtaining approximate urethral asepsis are recommended:

1. Have the patient empty his bladder when possible.

2. Place him in the recumbent position, his head comfortably elevated, but his shoulders on a plane with his buttocks. In some cases of retention, to facilitate the entrance of an instrument into the bladder it is necessary further to elevate the buttocks by means of a rolled blanket or quilt or a pillow.

3. Draw the patient's trousers and drawers down towards his knees, and fold his shirt-flap upward upon his abdomen.

4. Thoroughly scrub the inside and outside of a tin or agate water basin, twelve inches in diameter, in the presence of the patient. It is well to give all patients such an object-lesson whenever possible, to impress upon them the need of these precautions in such parts of treatment as must be relegated to them. Spread a clean towel upon the patient's thighs and covering his scrotum. Dry the basin inside and out with a clean towel, and while the basin is still warm place it on the towel in such a manner that its margin rests

FIG. 7.

in the peno-scrotal juncture, causing the pendulous portion to lie within the basin.

5. With cotton tampons soaked in mercuric chloride thoroughly cleanse the external (dermal) preputial surface, the internal (mucous) surface, the coronary sulcus, the sulci at both sides of the frenum, and the meatus, separating its lips to remove any secretion that may be visible between them.

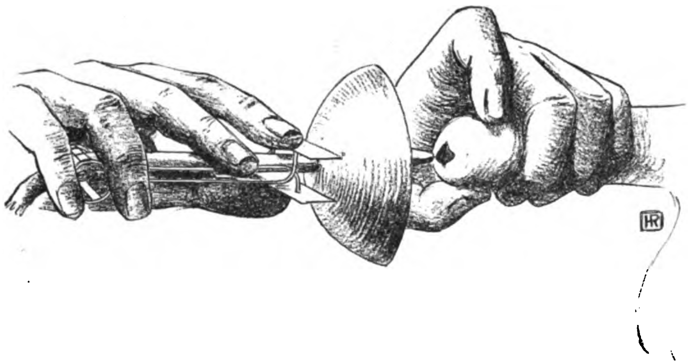
6. Envelop the glans in a small sheet of absorbent cotton soaked in bichloride solution.

7. Pour hot boric acid (four per cent. solution) into the auto-irrigator. About five hundred cubic centimetres (one pint) are ordinarily sufficient to wash the urethra. Hang the auto-irrigator four feet above the patient.

8. Sterilize the hands as before described.

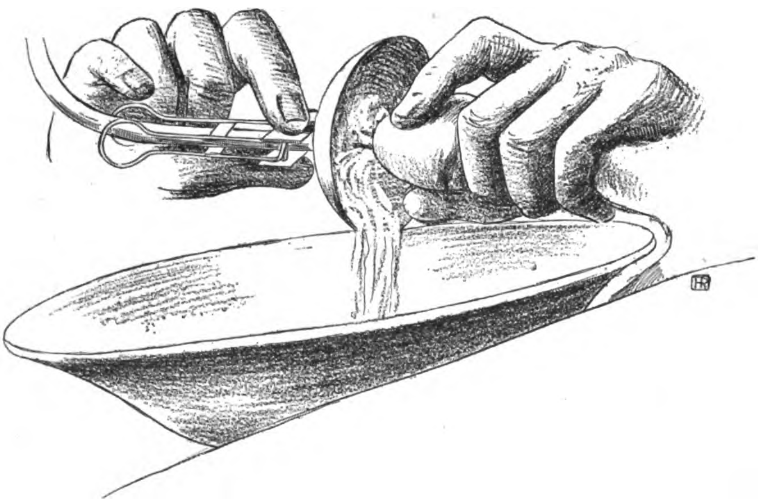
9. Remove the cotton with which the penis is enveloped and take the organ into the left hand in such a manner that the tips of the

Fig. 8.



middle, ring, and little fingers hold the left corpus cavernosum and slightly project beyond it, resting upon the urethra (but nowhere compressing it), at the same time pressing the right corpus caverno-

Fig. 9.

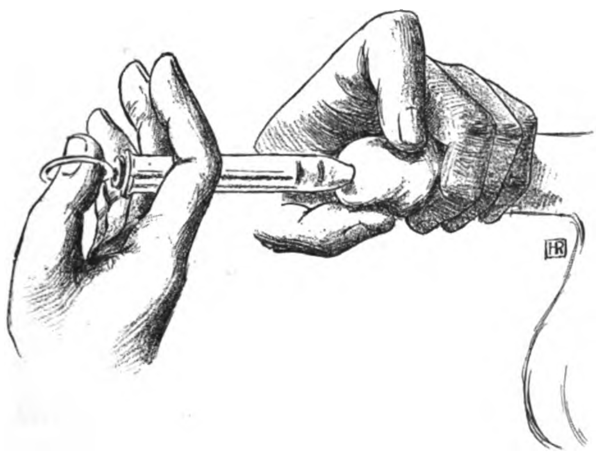


sum against the thenar eminence. This leaves the thumb and index-finger free to manipulate the glans and to separate the lips of the meatus.

10. Grasp the stopcock of the auto-irrigator between the right thumb and index-finger, and bring the nozzle to the meatus. A slight compression of the stopcock will cause the fluid to flow in a gentle stream or in drops, according to the amount of pressure exercised. Direct the stream of boric acid solution to all the parts that have been cleansed by the tampons with bichloride (see paragraph 4, on hand-disinfection) and in the order mentioned.

11. Insert the tip of the nozzle into the meatus and slightly increase the force of the stream until its impact is felt against the tip of the middle finger, which lightly rests upon the urethra. Let the jet play there until about one-fifth of the auto-irrigator's con-

FIG. 10.



tents have so been consumed. Then release the slight compression of the middle finger.

12. Repeat this procedure as far as the middle and little fingers extend; then compress the stopcock to the full extent, so as to send the remainder of the solution to the anterior face of the shut-off muscle.

If all these steps are correctly performed, and if the gentleness which is paramount in genito-urinary work is observed, the patient will not experience the slightest pain, and neither his garments nor his body will be soiled by a drop of the solution employed.

During the irrigation of the urethra the nozzle must never be driven into the meatus so tightly as to occlude it entirely, except for

the instant during which the urethral folds are smoothed out, so that the fluid may reach and wash all its parts.

In this connection it is well to remember that intravesical irrigations are not now being discussed.

After the urethra has been thoroughly washed, as before described, fill it with one or more small syringefuls of sterile glycerin containing five per cent. of iodoform. By carefully compressing the glans with the thumb and index-finger the urethra can be caused to retain this mixture.

The instrument or instruments to be used may then be inserted into the urethra, after lubricating them with lubrichondrin or synol.

When the purpose of instrumentation is attained we have reached the fourth and final step of our work, which consists in again irrigating the urethra, as was done prior to the operative procedure.

This synopsis of a method that has proved successful in the hands of many practitioners may cause it to appear complicated. In reality, all the steps of this aseptic procedure can be accomplished within ten minutes, certainly very little time to devote to the prevention of sepsis and of that avoidable disgrace to the profession,—infection.

EXTRAGENITAL CHANCRES.

CLINICAL LECTURE DELIVERED AT THE NEW YORK SKIN AND CANCER HOSPITAL, NEW YORK CITY.

BY L. DUNCAN BULKLEY, A.M., M.D.,
Attending Physician for Skin and Venereal Diseases at the New York Hospital, Out-Patient Department.

GENTLEMEN,—Syphilis is a great disease,—*the* great disease. It is no longer regarded as a necessarily venereal affection. There is probably more written about it than about any other disease except tuberculosis. Shelves are filled with the literature of the subject, and half a dozen journals are devoted exclusively to it. It is being studied the world over. Years ago syphilis was a scourge; to-day, it only occasionally attains such proportions. In olden times syphilis appeared as an epidemic. A few years ago I collected six or eight pages of recorded instances in which syphilis had been epidemic or endemic, and where twenty-seven, forty, or two hundred were affected in one town. From the time of Columbus, when the disease first appeared in Europe, it spread rapidly. It was not then thought to be venereal. It has appeared in some of the best families in New York. Some are innocently infected by occasional or constant contact in the social intercourse of families. There are many instances in which young girls have been innocently infected by their lovers, and purest women by their husbands. So be ever on the watch for syphilis. The disease is always communicated in one of two ways, it being invariably acquired from some person previously affected either by contact, mediate or immediate, or by inheritance. The most common mode of infection is through sexual intercourse. The presence of mucous patches in the vagina is sufficient to give rise to it. Of the ordinary run of skin cases seen in clinics and in private practice, syphilis is the cause in over ten per cent. In other words, over ten per cent. of the skin cases that come annually to this hospital, to the New York Hospital, and that I see in private practice are due to

syphilis, and number about two thousand four hundred. Of this ten per cent., or two thousand four hundred cases, extragenital chancre, on the finger, lips, etc., is present in no less than one hundred and thirteen. Fournier states that, in his judgment, twenty-five per cent. of the cases of syphilis are acquired innocently, and that in twenty-five per cent. of these cases there have been no sexual transgressions. We sometimes think that women get the disease in this way more frequently than men, but of the one hundred and thirteen cases referred to, fifty-nine occurred in males and fifty-four in females. From this it would appear that more cases of extragenital chancres are innocently acquired by males than by females.

These extragenital chancres affect various localities, as is shown in the following table:

Location.	Male.	Female.	Total.
Chancre of the lip	20	30	50
" " tonsil	8	7	15
" " finger	13	2	15
" " breast	..	7	7
" " tongue	3	3	6
" " cheek	5	.	5
" " eyelid	3	1	4
" " chin	2	1	3
" " hand	1	1	2
" " nose	1	..	1
" " ear	1	..	1
" " temple	..	1	1
" " neck	..	1	1
" " forearm	1	..	1
" " sacral region	1	..	1
Total	59	54	113

Next to the penis, the lips are the most frequent site of chancres; this is not wholly in accord with the literature on this subject, according to which chancres are more common on the breast than on the lip. The statistics embrace an enormous number of cases, found principally in the many asylums in Europe. Fournier says that there is nothing so dangerous to the community as a syphilitic child.

Chancres of the breast appear to be very common abroad, but we do not see many of them here. Yet I have, however, observed a number of them, probably eight or ten instances, some received

from suckling children, others from men. Taylor tells of a man who was forbidden intercourse with his wife, but did not think he was forbidden to apply his lips to her breast; this he did, and she developed a typical chancre of the mamma.

Here are some of Jonathan Hutchinson's wonderful plates showing a form of inoculable syphilis which is not often seen in this country,—that is, enormous vaccination chancres. Vaccination has been the source of a large number of cases of chancre in European cities, sometimes going through several generations. This is a subject to which Jonathan Hutchinson, of London, has devoted much study.

CHANCRE OF THE LIP.

CASE I.—One of the gentlemen present has been kind enough to send this case of chancre of the lip. The chancre has entirely healed, but the patient has an exquisite specific eruption upon the face. A letter sent me states:

"Mrs. B., a widow, has been treated by me since the middle of December, 1899. She then had a deep ulcer on the lower lip, a papular eruption on the face and body, enlargement of the lymphatic glands of the neck, and mucous patches over the tonsils. I informed her that I thought she was suffering from syphilis. She has been under mixed treatment, but the rash on the face still persists. The patient is not fully satisfied, so I refer her to you for proper diagnosis."

There is a small induration to the right of the centre of the lower lip; it is now undergoing ulceration. The ulceration of a chancre is exceedingly small. It is often mistaken for a "fever blister" or "cold-sore." Patients sometimes say they have a cracked lip. This one states that she does not know how she got this unless from a drinking-glass. Gentlemen, do not underestimate the danger of the drinking-glass as a source of infection. Hundreds of cases are traceable to it. The secretion from a mucous patch on the lips of one using the glass is capable of conveying the disease in this way, especially when the next drinker has an abrasion upon his lip. The lips should not be placed against the glass; the water should be supped from the surface when public drinking-cups or glasses are used. I have in mind two ladies who had chancre of the tonsils whose origin could be explained in no other

way. Epidemics have spread through schools through the agency of drinking-utensils. I have under my care now an old lady, who has syphilis, in whom the initial lesion, situated in the interior of the nostril, was acquired from a syphilitic grandchild. She was nursing—dry nursing—the child, and in some way her finger-nail became infected; she picked her nose, and as a result a chancre developed on the septum, and she afterwards developed one of the severest cases of nervous syphilis I have had. The disease ran on for months totally unsuspected,—the possibility of infection had occurred to no one.

Our patient has no knowledge of how she got the disease. There is now only a little hardness and no adenopathy. In suspicious cases always examine the nearest chain of lymphatics. She had an early macular syphilide. She came under the doctor's care in December, and yet the trouble persists. I wish especially to emphasize the fact that extragenital syphilis is likely to be more severe than that acquired from sexual intercourse; this is a uniform and universal observation. You should not make light of extragenital chancre; the patient should be made to understand its full significance. Locomotor ataxia and various other nervous affections may follow extragenital chancres.

In regard to this case, I am rather surprised that it did not yield to treatment. I would suggest the use of inunctions of mercury, pushed almost to the point of salivation. The patient should also take five or ten grains of potassium iodide in milk between meals.

The difficulty that attends the diagnosis of cases like the foregoing is illustrated by the following instance. A gentleman came to me with an eruption that proved to be a macular syphilide. I told him the nature of his trouble. He said, "No, sir!" I said, "How do you know?" He replied, "I have never been exposed." I examined him again,—his fingers, mouth, head, feet, and trunk, —but I could find the initial sore nowhere. Yet the condition was unmistakable. I told him that he had syphilis, and that infection had occurred within six months. I once more examined every part of his body, but to no purpose. I was naturally puzzled. I said to him, "Are you sure you have had no sore upon any part of your body within the last six months?" He replied that for a long time he had had eczema and itching about the anus. On inspecting this locality I found a typical chancre just above the anus.

Since that time I always examine that region in doubtful cases. How did it come? From a bathing-suit. He had had an eczema, and had been in bathing at Coney Island; he remembered putting on a bathing-suit which was not clean, and that it had rubbed the skin, so inoculating him thoroughly. There are several similar cases on record.

After my lecture last week a young man, a medical student, consulted me in reference to an eruption upon his own person. He had a maculo-papular eruption that was unquestionably specific. There was no trace of a chancre upon the lower region of his body, no sores upon his fingers, anus, or anywhere. In the back of his throat, however, over the left tonsil, I found a well-defined chancre. I have seen fifteen or twenty cases probably due to infection from drinking-glasses. In these the tonsils, which were large and succulent, were the seat of the disease. The crypts, which are closely connected with the lymphatic system, were large and especially exposed to infection from pipes or drinking-glasses.

CHANCRE OF THE LOWER LIP.

Case II.—This woman is twenty-six years old. Eight weeks ago she first noticed her "cold-sore." This lesion is a very common point of infection in cases of chancre of the lip that come from kissing.

We have in this hospital a lady with a chancre on her neck. She had a little sore there upon which a friend placed a piece of sticking-plaster, moistening it with her lip.

I have seen sores like our patient's upon almost every portion of the body; as many as sixty or seventy instances of them upon the lip. The chancre in this case is almost one inch in diameter, crusted, and with here and there a glairy secretion that is intensely contagious; the glands, too, are enlarged. This chancre was noticed eight weeks ago, but as yet there has been no eruption. This is unusual. The eruption should have been out before this, and may now appear at any time. Sometimes, but rarely, eight or ten months elapse before there is any sign of the eruption. The patient has had nightly attacks of headache, which prevent her sleeping. There is not much involvement of the glands beneath the jaw. There is no question as to the diagnosis. Such cases, when taken into the hospital, are treated by inunction.

CHANCRE OF THE LIP.

CASE III.—This patient developed a chancre six weeks ago, and there is already an exquisite maculo-papular syphilide over the entire body. He first had a "cold-sore." The vast majority of chancres of the lip occur upon the lower lip, because it is this lip that comes in contact with the drinking-cup or glass. This week I corrected the proof of an article on chancre of the upper lip, an unusual location, occurring in a child seven months of age, and probably originating from the feeding-bottle. Now, this man has a typical induration in a characteristic location. It is on the right side of the lip, probably because the pipe is held on that side. There is some induration beneath the jaw, but it is not very marked. There is also a little at the back of the neck and about the olecranon process.

CHANCRE OF THE EAR.

CASE IV.—This patient is twenty-one years of age. About election time, November 3, he was bitten on the ear in a quarrel. This entire area became the site of a chancre. Under appropriate treatment it entirely healed in three months. There is, however, on the forehead a small-grouped papular syphilide, one of the rarer early forms, which is also gradually fading. I wish to call your attention to this small-grouped papular syphilide, for when once seen, it can always be identified again, for there is no cutaneous lesion which resembles it.

As you know, infection takes place through the broken skin; poison that comes in contact with the uninjured integument cannot cause infection. The macular syphilide usually appears as early as the sixth week. Do not express a positive opinion as to the nature of a chancre of the penis until two months shall have elapsed. In one of these men the syphilide appeared six weeks, in the other three months after the primary sore. Syphilis, however, runs a pretty definite course. The later manifestations, such as the chloasmic pigmentary syphilide, do not occur until after the lapse of three months. Always investigate the natural history of the disease. Find out if there has been a general macular syphilide, first measle-like in character, afterwards papular, then larger papular, then tubercular, and finally, after two or three years, assuming other forms to which reference will be made hereafter.

We have a woman in the wards who is taking one-half a drachm of blue ointment; it is diluted one-half and used morning and night. Watch the gums carefully for salivation. The best application for the chancre is mercury; keep it covered all the time with mercurial plaster; nothing answers so well as mercury applied in this form.

One of these men was given the protoiodide of mercury early in the disease. As I told you before, I prefer mercury itself, as in combination with chalk, given almost to salivation.

One is surprised to learn how frequently patients suffering from the early macular syphilide are unaware of the existence of syphilis. I have been consulted by patients with an extragenital chancre on account of the eruption. Now, this man with chancre of the lip was totally unconscious of the nature of his trouble until last Friday, yet he has been going around New York City with an undiagnosed chancre on his lip. There has been enough secretion conveyed from that sore to the glasses at the bars he visited to infect every person afterwards using them. A maker of cigars whose lips were covered with mucous patches once told me that he often rolled the cigar upon his lip.

CHANCRE OF THE LIP.

Case V.—This patient is twenty-six years of age. She was admitted to the hospital last week for treatment. She has had a chancre for six weeks, but no lesion of the skin has as yet been observed. She suffers from intolerable frontal headache, which is so severe that morphine is given every night. I wish I had more time to speak of syphilis occurring in women. Fournier wrote a book upon this subject. Many women with both genital and extragenital chancres escape the skin lesions until late in the disease, when the gumma or tubercular syphilides appear. I cannot tell why this is, unless the menstrual flow carries off the poison. This woman has had her sore on the lip nearly seven weeks, but there is no vestige of the faint macular syphilide yet visible scattered over the face. The lip is large and pouting, there is some soreness and enlargement of the glands on one side, and nocturnal headaches, and these are the only symptoms. Locally, she is using mercurial plaster, laid in strips and changed twice daily. She is also receiving inunctions of one drachm of blue ointment. There is no salivation,

and the headaches have been relieved. For these headaches I find antifebrin very valuable. I order five grains about nine o'clock at night, to be given in hot water with two drachms of whiskey; at the end of one hour I order the second dose. If the patient gets blue about the mouth, there is no harm done if the whiskey be given. This usually affords relief at night. This case is interesting because it would be difficult to make a diagnosis of her condition at first sight except by exclusion.

In regard to treatment, mercury is the only drug. It may be given by hypodermic injection, but this plan of treatment is falling into disuse. I prefer to give mercury and chalk in tablet form, one grain every two hours; this is Hutchinson's plan of treatment. I adopted it ten or twenty years ago, and have used it continuously. If one-grain doses are given early in the disease, the results will be entirely satisfactory. In some instances it is necessary to double the dose.

Mercurial baths are sometimes very efficacious in troublesome cases. One, two, or three vapor baths may clear up the eruption and relieve the symptoms of nervous syphilis. Potassium iodide is a drug Dr. Fisher refers to; his patient took five hundred grains a day. That amount is given at Hot Springs, in Arkansas, as a matter of routine. I do not believe in pushing the drug to this extreme.

THE TREATMENT OF SOFT CHANCRES.

CLINICAL LECTURE DELIVERED AT THE ST. LOUIS HOSPITAL, PARIS.

BY ALFRED FOURNIER, M.D.,

Professor of Skin and Venereal Diseases in the Paris Faculty of Medicine.

GENTLEMEN,—The soft chancre is an exclusively local disorder which never produces general infection of the system; it therefore requires local treatment only. All general treatment, particularly the internal administration of mercury, is useless; and yet, in certain countries, even at the present time, mercury is prescribed for this affection,—a course which, I need scarcely tell you, may prove distinctly disadvantageous to the patient.

This does not mean, however, that you are not to take into account the patient's constitution, nor regulate the diet of plethoric patients, and build up such as are run down.

Let us consider what local means can be employed for the cure of the soft chancre. This is an important and by no means simple question, as is shown by the numerous methods of treatment that have been brought forward at one time or another.

This form of ulcer being a purely local process that lasts for several weeks, why not cure it radically by at once removing the entire lesion surgically? Unquestionably this procedure will be successful if the chancre is a small one; still, it is important that a remedy should not be worse than the disease it is intended to cure, as surgical intervention may be when there is one large chancre or several discrete ones. In the latter case it is necessary to perform a number of separate operations, to remove a certain amount of tissue, and under circumstances that entail no little risk of infection of the wounds. A therapeutic method, therefore, that occasions what is almost a mutilation, or, at any rate, an extensive loss of tissue, is not a practical one, and had better be abandoned. Yet there is one condition in which this operation is indicated,—when there is a long foreskin complicated by phimosis; circumcision will then relieve both disorders at once.

The excision method has recently been recommended anew in Germany by Unna, who has modified the process somewhat and calls it "the abrasion of the chancre." The ulcer is frozen with ethyl chloride and is then cut out with a razor to a depth of from two to four millimetres; recovery is said to be very rapid and to leave no cicatrix. Gentlemen, this is to me absolutely incomprehensible, and I do not believe that such a wound can heal without a cicatrix.

If the chancre were an ordinary sore, being small, it would heal in a week. To last so long, then, the activity of the morbid process must be maintained by some special cause. Is it possible to destroy this special virulent element and convert the chancre into an ordinary wound? This course is perfectly feasible, as can easily be demonstrated experimentally; a chancre that is thoroughly cauterized remains sterile, and cannot be reinoculated.

To accomplish this in practice powerful caustics are required, —caustic potash, sulphuric acid, zinc chloride. Silver nitrate (even when applied in the form of powder) is insufficient.

We must, therefore, have recourse to very active preparations that will produce an eschar, such as the actual cautery, caustic potash, sulphuric acid, and the Vienna and Canquoin pastes.

In order for cauterization to be effective it must act on every part of the lesion. Now the actual cautery does not meet this requirement, for with it it is impossible to get under the edges and into every diverticulum of the chancre.

With a chemical paste, on the other hand, no part can escape, as the remedy fuses everywhere. I can recommend the following preparation which was used by Velpeau and Ricord: sulphuric acid and powdered charcoal mixed in such proportions as to make a semi-solid mass resembling blacking; of this a portion about the size of a lentil is applied with a spatula to the chancre and covered with cotton wool and a bandage. This hurts a good deal when first applied, but the pain disappears in a very few minutes. A hard black crust is formed on the chancre that falls off in from six to fifteen days, leaving a wound that is healed or in process of healing. My experience in the use of this preparation convinces me that it is the most satisfactory of the remedies used in the treatment of this affection. If the application is properly made the chancre is utterly destroyed as a focus of contagion; the result is perfect from every point of view.

But—for there is a but—this method has its counter-indications.

When there is but a small chancre,—the inoculation sore, for instance,—the indication is absolute, for in such a case this means for curing the chancre in its incipiency is marvellously efficacious.

It is, however, not applicable:

First, when the chancre has attained its full development. There can then be no advantage in creating in its stead a larger sore that will heal no sooner than the original lesion.

Second, when all parts of the chancre cannot be reached, or when there is any possibility of reinoculation in the neighborhood; a chancre on the foreskin, for instance, should not be treated in this way when there are others beneath it.

Third, when cauterization might destroy important tissues, as when the chancre is situated in the urinary meatus, in the urethra, or in the anus.

Fourth, when the resulting cicatrix would be too conspicuous. The genitals have their coquetry, and the remedy should not cause greater disfigurement than the disease.

In such cases other means must be adopted to destroy the virulence of the ulcer. A curious fact noticed in connection with the soft chancre is that if pus taken from it be kept at a temperature of 38° C. (100.4° F.) for eighteen hours it loses its virulence. The following therapeutic experiment based upon this observation was tried, it is said, with success. The patient was placed from twelve to eighteen hours in a bath at 40° C. (104° F.) with cold cloths applied to the head. A bath at this temperature and of such duration raises the temperature of the body, which is not without danger. For this reason the first method was replaced by the *local* application of heat; a coil in which water at 50° C. (122° F.) circulated was kept around the penis for forty-eight hours. These methods, however, were open to many objections and had to be abandoned.

In ordinary cases of soft chancre there are three essential indications:

1. To isolate or sequestrate the chancre.
2. To prescribe an appropriate local hygiene.
3. To modify the ulcer, if possible, by local applications.

Of these, the isolation of the chancre is by far the most im-

portant. It should at once be covered with absorbent cotton, which will take up the secretion that otherwise, by flowing over the neighboring parts, would cause the development of other chancres.

Hygienic measures must be general as well as local. All alcoholic drinks must be forbidden, as it has been remarked from time immemorial that they invariably aggravate the disorder. The chancre itself must be kept scrupulously clean by frequent washing and careful and repeated dressings. An excellent practice, which should not be omitted, is the daily use of the warm bath.

Finally, the chancre should, if possible, be modified by suitable topical remedies, such as aromatic wine, silver nitrate, ferric chloride, ferri et potassii tartras, tannin, iodoform, aristol, iodol, resorcin, europhen, etc.

Many of these substances have been introduced into practice more or less recently, and are supposed to accomplish wonders. But, gentlemen, you must not believe all that is said about them; the new remedies are no better than the old ones, for the very simple reason that the natural tendency of the soft chancre is to heal. It can be treated and cured with no other remedies than water, cleanliness, and cotton wool. This I have done.

Nevertheless, among the above enumerated preparations there are three that are of unquestionable value: the solution (one in ten) of ferri et potassii tartras, recommended by Ricord, iodoform, and silver nitrate, especially the last two.

Iodoform is certainly the best local application for the soft chancre; but its penetrating odor, so difficult to counteract, is a serious disadvantage. Patients will frequently absolutely refuse to use this remedy, which they think betrays them. In such cases a compromise can be proposed which will generally be accepted; let the chancre be dressed with iodoform during the night only, and during the day something else, dry cotton wool or silver nitrate, can be substituted. The latter substance must always be used in solution and in the same dilution: one to thirty. Experience has shown that a weaker solution is not sufficiently active, and a stronger one is too irritating. The patient should dip a very thin pledget of cotton in the solution, apply it to the sore, and cover with dry cotton to absorb the excess of liquid. Each chancre should have its individual pledget.

The silver nitrate solution is not suitable for all stages of the

disorder. During the first period it is always useful; but when the ulcerative process begins to decline and the virus has lost its potency, it should be replaced by dry cotton or by an inert powder, such as bismuth.

There are some forms of treatment that are positively injurious. Among these may be mentioned:

1. Cauterization by solid silver nitrate, which aggravates the lesion and renders the chancre red, painful, and swollen.

2. Dressings with ointments, which are, as a rule, distinctly unfavorable for the soft chancre.

3. Treatment by mercurial ointment, which is also harmful, and capable, as shown by Ricord, of favoring phagedæna.

Soft chancres in particular regions often require special treatment.

When the chancre occurs on the pubis the hair must be removed from the region.

The simple chancre of the anus generally lasts for a long period and is difficult to dress. The silver nitrate solution cannot be used in such cases, as it is too irritating; the best plan will be to apply a preparation of vaseline and iodoform, one in ten, and spread it on a dressing to be inserted into the orifice of the anus. See that the patient does not become constipated, and before the bowels are moved let an enema of oil be given and have the anus anointed with some fatty substance.

Chancre of the urethra is also difficult to treat. If situated at the meatus, it should be powdered with iodoform and covered with cotton; but if farther in, it should be let alone. Chancre of the urethra heals readily, and is intolerant of local dressings or pharmaceutical bougies. The treatment should be restricted to demulcent drinks.

The *sub-preputial* chancre is a form frequently met in practice. How is it to be managed?

If the patient can uncover the glans easily, dress with iodoform or with the nitrate of silver solution and bring the foreskin over again; slight difficulty in retracting the foreskin is no contraindication if not sufficient to cause paraphimosis. If there appears to be danger of this complication, the case should be treated like one of balano-posthitis,—that is to say, by subpreputial injections to cleanse the region and to modify the chancre. A soft

catheter, No. 14 or 15, French, attached to the nozzle of a syringe, is inserted under the prepuce and carried back until it reaches the cul-de-sac; through this inject pure water until it comes back quite clean; then throw in a solution of silver nitrate, one to two hundred. Do this night and morning, and give two or three sterile-water injections during the day.

The soft chancre of the uterine cervix, like other internal soft chancres, heals easily; the chief danger is possible infection of the vulva. It must, therefore, be isolated. Touch it each day with the one to thirty solution of silver nitrate, dust with an inert powder, such as bismuth or tannin, and cover it with a tampon of cotton wool.

URETERAL CATHETERISM IN THE MALE; A NEW URETER CYSTOSCOPE.

BY BRANSFORD LEWIS, M.D.,

Professor of Genito-Urinary Surgery in the St. Louis College of Physicians and Surgeons.

The following recently reported case [1] illustrates not only the desirability of possessing the means of avoiding such an unfortunate result as depicted, but also the embarrassing position in which the surgeon finds himself in certain cases when deprived of such a means:

"A girl of twenty-one years was subjected to laparotomy because of absence of the vagina and the presence of a tumor in the pelvis which was thought to be a hæmatometra, and an artificial vagina could not be made. The operation was undertaken in order to remove the ovaries and prevent further menstruation. The left ovary was readily found and removed. The tumor was incised, and found to be a sac containing a hard body and a mass consisting chiefly of dark blood-clots. When the operator was about to remove the tumor he found connected with it a cord running downward, which led him to suspect that the tumor might possibly be a kidney. It proved to be a kidney, with marked fœtal lobulations and portions which were decidedly hypertrophic and others equally atrophic. The patient passed no urine after the operation, and became nauseated. She was given packs and sweat-baths, which afforded some relief, but the weakness increased. She became apathetic; the left parotid swelled, the swelling finally becoming so great as to interfere with breathing. She grew restless, the pulse became small, and strength was lost rapidly. Seven days after the operation she was somnolent, the pupils were contracted and unresponsive to light, and she died, with temperature subnormal. On post-mortem

[1] Zeitschrift für klinische Medicin, vol. xxxviii., No. 5, and the Philadelphia Medical Journal, June 23, 1900.

examination there was no sign of peritonitis. The uterus and vagina were absent, likewise the right kidney and its ureter, and the right ovary. The tumor that had been removed was the only kidney."

Under such conditions, of course, uræmia and death were inevitable. The diagnosis and operation were not made by an amateur, but by one of the masters of the surgical art in Germany. And such an occurrence is not by any means unique with him. The same thing has been done a number of times by others, and the records of operative work on the kidney, so brilliant in other directions for the last thirty years, have been greatly marred in this respect through lack of completeness in diagnosis, either preliminary to or during the operation. De Jong's statistics of one hundred and ninety-seven nephrectomies, with eighty-one deaths, record two of them (two and one-half per cent.) as depending on the fact that the other kidney was absent, and there were nine others in which the patients died because the other kidney was so diseased as to be unable to carry on its functions. This makes eleven cases, or thirteen and one-half per cent., in this series alone, in which death was contributed to by the operation.

That the profession of the world has appreciated this unfortunate source of danger in renal surgery, and has tried its utmost to remedy it, is indicated by the persistent endeavor that has been made in various directions to secure a more refined and complete diagnosis of kidney conditions before any such radical operation is undertaken. For this purpose such heroic measures have been advocated as suprapubic cystotomy for ureteral catheterization (Harrison, Guyon), or exploratory laparotomy for the purpose of palpating both kidneys (Knowsley Thornton). It is evident that the latter procedure can establish nothing more than the presence of the kidneys, as it furnishes no information as to the state of either organ.

Of late years, more useful and less radical procedures have come into vogue, the endeavor being made to secure the urine of each kidney separately by means of catheterism or the occlusion of one ureter at a time. The ureter-catheterizing cystoscopes of Nitze, Brenner, Casper, and Albarran, and the urine segregator of Harris have been most favored by the profession.

The cystoscopes mentioned have all been based on the principle

of the earlier cystoscopes of Nitze and Leiter, with telescope lenses, hot electric lamps, and tubes for the conduction of small ureteral catheters. Theoretically, or when used in the phantom (artificial) bladder, filled with clear fluid that does not become opaque, these instruments seem to work perfectly: the artificial ureteral openings can be plainly seen and the catheter can be readily introduced; but usually, when we come to make practical use of them on a patient affected, for instance, with hæmaturia or some obscure urinary lesion, our troubles begin. We find that on account of the complicated mechanism of the instruments, with their telescope lenses, refractors, magnifiers, and hot electric lamps, all of which must be perfectly adjusted in order to be of service, or by reason of the conditions under which it is necessary to use the instruments (clear fluid is required, not too cold nor too hot, and in sufficient quantity to afford working-space for the instrument), difficulties present themselves, and in a large proportion of cases to a degree that makes the operation impossible, even in the hands of skilful and experienced surgeons. In a series of twenty-eight attempted ureteral catheterizations in the male, reported by Dr. Tilden Brown,[1] there were seven failures, or twenty-five per cent. There can be no gainsaying the fact that this is far too large a percentage of failure for a surgical procedure. Besides, this series represents the results obtained by those most accustomed to the work, and, presumably, most skilful in its execution. Attempts by unskilled hands will undoubtedly be attended by a much larger percentage of failures. If such be the case, the instruments for ureteral catheterism in the male hitherto in use fall far short of affording satisfaction, to say the least.

This is likewise true, in my opinion, of the Harris segregator. It not only causes an unbearable amount of pain in a number of cases, even after the generous use of cocaine, but its results are unreliable. I have reached this conclusion not only from my own experience with the instrument, but have also had equally unfavorable opinions expressed to me by several professional acquaintances. It may drain from one side and not the other, for a time, and later stop draining from the first and begin to drain from the second; or bloody urine may come from both sides when it

[1] Annals of Surgery, December, 1899.

should come from only one. An enlarged prostate is apt to lessen the efficacy and reliability of this instrument at all times.

My inability to use satisfactorily the instruments for urine differentiation in the male heretofore in the market has been the incentive for the construction of the ureter cystoscope herewith presented. Its fundamental object is the catheterization of the ureters in the male, but it may also be used in the female, although this has been already well provided for by the Pawlik-Kelly method.

I have succeeded in catheterizing the male ureters with this cystoscope a number of times when I had been unable to use the older forms (Casper's, Nitze's, Albarran's) successfully, and I believe that with practice and the full development of its possibilities it will give far better and more certain service than any of its rivals.

It consists of a tube, A, Fig. 1, which carries in its upper wall a smaller tube, B, for the conduction of the wires that connect with the electric lamp, C, and in its lower wall another small tube, D, for the conduction of the silk-web ureteral catheter, and for guiding and controlling its inner extremity after it reaches the bladder cavity. The light from the lamp emerges through the glass window, E, sealed in the roof of the main tube. The lamp, when burnt out, is removable by unscrewing the cap, F, and pulling it out, together with the wires to which it is soldered. To facilitate the introduction of the cystoscope, an obturator, O, Fig. 3, is furnished, which closes the distal orifice and prevents scraping of the membrane against the edges of the opening; but these edges are so rounded that they may be brought in contact with the membrane without injury to the latter, so that the cystoscope, if withdrawn from the bladder into the prostatic urethra, may be pushed back into the bladder without the necessity of reinserting the obturator.

A glass-covered cap, G, may be placed over the ocular end in case it is desired to distend the bladder forcibly with air when that condition is not effected by posture. The inflation is made by a rubber bulb attached to the stopcock H.

The ureteral catheter which I employ is the same as that furnished with the Casper cystoscope. The lamp made use of is the small Mignon lamp lately introduced, which, while affording a brilliant glow, radiates so little heat that it may be held within a quarter-inch of live tissue for an indefinite period without occasion-

ing discomfort, much less pain. It is this property of the electric lamp that constitutes the chief advantage of this instrument. A hot lamp requires the shield and protection of fluid before it can be introduced into the bladder, whereas this can be used with perfect safety and comfort, so far as heat is concerned, in the *empty* bladder. Thus the use of fluid, with its numerous disadvantages, such as rapid clouding by inflowing pus, blood, etc., is no longer

FIG. 1.

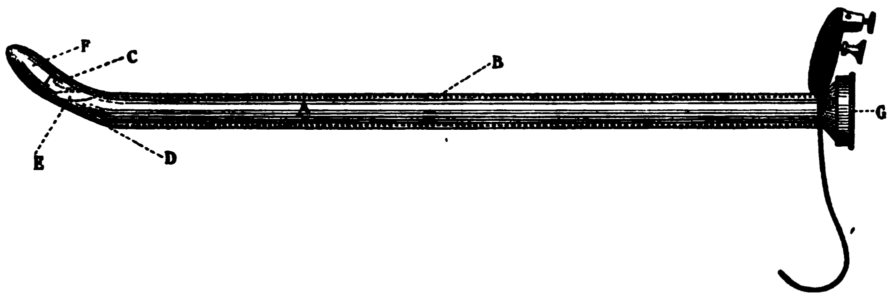


FIG. 2.

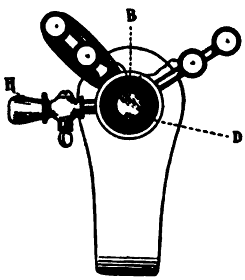
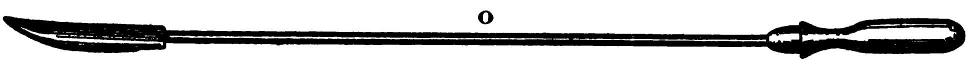


FIG. 3.



necessary. Some years ago Belfield, of Chicago, presented a cystoscope somewhat similar to this one in that it was designed to be used in the empty bladder and lighted by internal electric illumination; but because of the heat produced by the lamp in use at that time it was found to be of no practical value.

From the brief description given, it is evident that the instrument is extremely simple. Its freedom from complexity relieves it

of many of the sources of difficulty encountered in the use of the older forms. It has no lenses to intervene between the eye and the object of investigation. Lenses must be perfect in order to be of service, and perfection in them is both expensive and difficult of attainment; and after perfection has been attained the usefulness of the instrument may be destroyed in an instant by the slightest displacement of the lenses or the clouding of the cement that secures them. A year ago my Leiter cystoscope gave trouble in this way, and it had to be sent to Europe, and it was six months before it was in my hands for use again.

The window in this instrument is so placed that, should it become smeared with pus or blood, it may be cleaned by a cotton swab without removal from the bladder. The lamp is brought within a half-inch of the membrane in searching for the ureteral opening, and the closeness and directness of the illumination thus obtained are of great advantage in facilitating its discovery. It is well known by those who have studied this subject that it is a difficult matter to find a ureteral opening even under the most favorable conditions, for instance, with the bladder laid open before the eyes; so that any device that favors its exhibition should be taken advantage of. It is doubtless true that no instrument will ever make the operation of ureteral catheterization so easy that it may be invariably accomplished by those unaccustomed to the work.

In mentioning some of the impediments to ureteral catheterization with the Casper, the improved Nitze, the Brenner, or the Albarran instruments, Brown (*ibid.*) referred to the difficulty of inserting the catheter where there is a precipitous trigone; indeed, this condition is put down as "impracticable of entry with any style of catheter cystoscope." It is probable that such a difficulty will be overcome with this cystoscope with the patient in the knee-chest position. In that position, the bladder being inflated with air and drawn downward and forward by the abdominal viscera, the trigone is brought forward and into view, within reach of the catheter. If necessary to further the same end, the rectum may also be inflated or distended with a colpeurynter.

Another difficulty to which attention is called in the same paper is that met with when the bladder is so acutely sensitive or contracted that only two ounces or less of fluid can be retained in it. This small amount does not afford enough working-space for the

instruments mentioned, with the exception of the Brenner, and it cannot work in less space than that furnished by the amount of fluid above mentioned. In using the present instrument no fluid is introduced at all; on the contrary, the bladder is emptied as thoroughly as possible beforehand, and it is not desirable to have it distended to any marked degree, even with air. The absence of fluid prevents clouding of the field of view by inflowing pus or blood. Indeed, the emergence of bloody fluid from a ureteral opening often assists in the discovery of the latter by marking its location.

Sterilization.—It is well known that the cystoscopes in the market are not sterilizable by dry or steam heat, as ordinarily applied, because of the delicacy of their construction and the presence of cemented lenses. Before using this cystoscope, the lamp is temporarily removed and the remainder of the instrument may be placed in a heat sterilizer as long as is desired.

In a recent paper on a subject allied to this, Lilienthal[1] says: "In by far the greater number of cases in which catheterization of the healthy ureter is practised, disease of the other kidney or of the bladder is present, and the region about the ureteral orifice, not to mention the ureteral mucous membrane, is anything but sterile. Efforts at disinfection are of necessity incomplete, because it is not possible to disinfect mucous membranes, and because there is constant soiling from the other ureter. The danger is theoretically, and perhaps practically, minimized when the catheterization is done by the dry method of Kelly, in which the ureteral catheter need not touch any tissue except that at the mouth of the ureter itself." The same advantage is afforded by this cystoscope, which employs the "dry method." The inner walls of both cystoscope and catheter-carrier are sterilized as mentioned, so they do not contribute any organisms to the sterilized catheter, and the catheter emerges from the inner extremity of its carrier to pass directly into the ureteral opening without coming in contact with either fluid or mucous membrane save that of the ureter itself.

I have not attempted to make especial provision for catheterizing both ureters at the same time; but there are two ways in which double catheterization may be accomplished: by making the catheterization of the two ureters at successive *séances*, or successively at

[1] Journal of Cutaneous and Genito-Urinary Diseases, March 1900.

the same *séance;* or, after the ureter catheter is introduced into one ureter, a small soft-rubber catheter is introduced into the bladder through the main tube; both catheters are allowed to remain in their positions as the cystoscope is withdrawn; one of them drains directly from the ureter, the other from the bladder cavity, which, of course, contains only the urine from the other ureter. As to whether this manœuvre is perfectly reliable, and affords no opportunity for a mixing of the two urines through the escape of some of the urine alongside of the ureteral catheter, is questionable. However that may be, some operators depend on it, notably Guyon. If the catheter fits in the ureter tightly, it will probably not allow any escape; but if from patency of the opening it is a loose fit, one should not rely on this method, but resort to successive catheterizations. "Double-barrelled" ureter cystoscopes cannot accomplish double catheterization of the male ureters at the same time; the anatomical conditions will not permit of it.

Technique.—General anæsthesia is not necessary for the use of this cystoscope. Except for the unusual position (the knee-chest) in which the patient is placed, the operation differs little from the introduction of an ordinary steel sound and such manipulation as would be made use of in an examination for stone. If the ureteral opening is readily found,—and facility in discovering it should come with practice,—there is no difficulty in inserting the catheter into it, after which the cystoscope is immediately withdrawn, the patient placed comfortably on his back, and the draining of urine directly from the ureter is continued as long as desired.

For these reasons cocaine anæsthesia suffices. It is best effected in the following manner: the anterior urethra having been anæsthetized by injecting a half-drachm of five per cent. cocaine solution into it with an ordinary penile syringe, using air to distribute the solution over the membrane of the whole anterior part of the canal, a urethral medicated tablet-depositor is inserted into the posterior urethra, where a one-grain cocaine tablet is deposited and allowed to remain until it dissolves; then the depositor, with the obturator in place, is moved back and forth until the posterior urethra is thoroughly anæsthetized. After that, another tablet (or possibly two, if necessary) is deposited just within the bladder, at the trigone. There must be only a very small quantity of urine in the bladder at this time, otherwise the dilution of the cocaine will

prevent anæsthesia. The tablet form is usually much more effective than the solution. I have had a tablet-depositor constructed that answers the purpose better than those ordinarily found in the stores. It has two obturators, a blunt and a conical one, and the staff of each obturator is especially pliant and flexible, which obviates jerky movements when introducing or withdrawing it.

It is presumed that the bladder and urethra have been previously washed out well with boric acid solution, so that now, with effective anæsthesia accomplished, the patient is placed in the knee-chest position, with the knees separated about twelve inches. The operator then inserts the cystoscope into the urethra and bladder, elevating the instrument rapidly as the fixed portion of the urethra is passed. Freedom of motion indicates that the bladder cavity has been reached. The obturator is withdrawn, and immediately there is an inrush of air that fills the bladder as the abdominal viscera fall towards the chest and pull on its fundus. It may be now necessary to pump out some remaining urine with the bulb-pump furnished for the purpose, or to swab out the cystoscope-tube or clean the window. After that the current is turned on and search is made for the ureteral opening of one side. This should be found at one of the upper angles of the trigone, and may appear either as a narrow slit at the end of a slight ridge or as a dimple on a slight elevation. If it is not soon observed, the ureteral probe may be used to discover an opening. Once found, the remainder of the task is easy: the ureteral catheter is run along its carrier into the ureter for a distance of two or three inches or more, and the cystoscope is taken out, as before mentioned. The catheter can be seen passing into the ureter after it is engaged as indicated, and it can be demonstrated to others as well, the ridge which it causes showing the course of the ureter.

While no especial stress is laid on the value of this instrument as a cystoscope, *per se,* its object being primarily the catheterizing of the ureters, the view it affords of the interior of the bladder should not be overlooked nor neglected. It is similar to the picture presented by the Kelly cystoscope in the female bladder, which in certain respects is superior to that presented by the lens cystoscopes. Aside from the disadvantages of a fluid medium, already mentioned, these instruments give an inverted image, and, corresponding to the magnification of the field, there is contraction of its area. In other

words, there are these several modifications of the image before it gets to the eye of the observer. He may or may not be able to interpret and judge them correctly, but with the cystoscope under discussion there is absolutely nothing to intervene between the object and the eye, so that what *is* seen is seen without any modification whatever. Moreover, to the sense of sight may be added that of touch by means of the probe; so that when one is in doubt as to what he sees he can add the testimony of the probe on the subject.

Therapeutic applications or operative measures may be carried out through this cystoscope as they are carried out through the endoscope. Although I have not had occasion to try it, I have no doubt that electro-cauterization could be done, under certain limitations, and washing of the kidney pelves can be done as practised by Kelly in the female.

Bladder Contractions.—I have found, in two cases, an almost irresistible tendency to bladder contractions shortly after the introduction of the instrument; in fact, they occurred after the introduction of other instruments as well,—the Harris segregator, for instance. In order forcibly to resist this tendency, I have had the air-tight glass cover, G, and the stopcock, H, added to the previous model. If it is necessary to use these until the ureteral opening is located, they can afterwards be discarded, the cap being removed and the catheter inserted as before described.

GUMMA OF THE PENIS; HEREDITARY SYPHILIS; TERTIARY ULCERATIVE SYPHILODERM.

BY WILLIAM S. GOTTHEIL, M.D.,

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Gentlemen,—I have an opportunity to-day to show you some cases of syphilis which will be of interest from a diagnostic point of view.

The first patient is a man of twenty-seven, apparently in vigorous health, who consults us in regard to an ulceration of the sheath of the penis which has been present for several weeks. On the dorsum of the organ there is a deep, irregularly circular loss of tissue, with a ragged, uneven base showing scattered masses of necrotic tissue, more or less undermined edges, and considerable induration of the tissues under and around it. Four weeks ago there appeared at this point a little red pimple, as he terms it, which he discovered accidentally, as it was entirely painless. It grew to the size of a large bean, and then broke; the induration and ulceration gradually extended until the sore attained its present size.

I shall ask no questions in regard to the patient's history until after we have made a diagnosis of the condition. This is a point upon which I cannot insist too strenuously in all dermatological and venereal cases. We are not compelled to draw deductions from obscure physical signs and symptoms that admit of various interpretations. The lesion lies open before us for examination by sight and touch, and even for microscopic investigation, should that be necessary. That should be sufficient for us; besides, the history, even if honest, may be incorrect or misleading. After we have come to a decision we may, for our own satisfaction, inquire into it; but it can only confirm our conclusions or leave them as they were.

Now, the condition which this man presents is one that is undoubtedly responsible for many errors in diagnosis, and has had unfortunate consequences both from a scientific and a purely personal point of view. Any lesion of the genitals, more especially

if ulcerated and indurated, is very liable to be called a chancre by those whose professional work does not bring them much in contact with venereal diseases. Induration and ulceration are indeed common features of the primary lesion of syphilis, but they are not necessary ones; they occur with other lesions, and they are by no means characteristic. Some years ago I called attention under the name of "pseudo-chancre" to several affections of the genitals that in many respects simulate the initial lesion of syphilis, and frequently lead to errors of diagnosis and mistaken opinions as to reinfection with specific disease.

Examining this lesion closely you will find that the induration, though pronounced, is not of cartilaginous hardness nor sharply circumscribed, but merges insensibly into the surrounding tissues, and is, besides, more or less soft and doughy. In other words, while induration is present, it is not the induration characteristic of chancre. The ulceration itself is rather opposed to that diagnosis. We must never lose sight of the fact that the initial lesion of syphilis is a tumor, and that loss of tissue takes place only secondarily and accidentally. Often there is no loss of tissue at all, sometimes there is only a superficial erosion. Even when exulcerated, the loss of tissue in the chancre is superficial, and the characteristic tumor is recognizable under the base and in the margins of the lesion. Both these features of the ulceration under consideration, therefore, militate against the diagnosis of chancre.

The condition of the lymphatic glands, moreover, will help us in coming to a decision. With the chancre there invariably occurs the general adenopathy so characteristic of early syphilitic infection. Examining this patient's lymphatic glands, we find that those of the inguinal region are slightly enlarged, but no more than we would expect with any ulcerative lesion of the genitals; there is no general glandular enlargement.

Chancre being thus excluded, there remain only two or three other lesions to be considered. A chancroid would be very painful and tender, would have a marked inflammatory areola and no induration, and would, in all probability, be accompanied by a chancroidal bubo. The recent advent, rapid progress, and appearance of the sore, as well as the age of the patient, preclude carcinoma. A tuberculous ulceration would be extremely chronic, would show miliary tuberculous nodules around the margins of the original

FIG. 1.—Gumma of the penis.

lesion, and would probably be accompanied by the evidences of tuberculous disease of the lungs. There remains only the gumma; and of this late evidence of constitutional syphilis the sore under consideration is a typical and excellent example.

We are now at liberty to inquire into the patient's past history, and we find that he gives account of a syphilitic infection several years old. Such confirmation of the diagnosis is always welcome, but it would make no difference at all if no such data could be obtained from him.

The second case is an example of a class which we probably see less of in dermatological than in the pediatric clinics and in general practice. The child has been under our care for a number of months, and its history is, briefly, as follows:

Some ten months ago the child, then four months old, was brought here suffering from hereditary syphilis. There were moist papules around the anus and mouth, a sparse general maculo-papular eruption, and buccal mucous patches. Very little nourishment had been taken for a number of days on account of the latter condition. The child was vigorously treated with mercury and chalk and the tannate internally, and with inunctions. Its condition improved for a time. The dermal and mucosal lesions disappeared, and more nourishment was taken. Then there developed enlargements of the liver and spleen, and some ascites, and the child's condition became worse. Gummatous ulcerative lesions of large size appeared upon the back, the scars of which are still visible. Then there occurred a meningitis, probably gummatous, from which the child was at death's door for several weeks. Time and time again she was brought to the clinic showing all the characteristic symptoms of meningeal inflammation, and with a temperature of 104° F. and over. At each reappearance we were astonished to find the child still alive. Medication by the mouth became impossible, the gastro-enteric tract rebelling to such an extent that it was impossible to nourish the child. Mercurial inunctions and baths had to be stopped on account of the dermal irritation that they caused. We finally had recourse to the soluble metallic mercury, of which drop doses of a one per cent. solution were administered in increasing amounts, until as much as sixty drops were taken daily for long periods.

This treatment seemed to do well, and finally the meningeal

inflammation subsided and disappeared. The ulcerations on the back healed, and the tumefactions of the internal organs became regressive.

The patient is now well, so far as the active manifestations of syphilis are concerned. The abdominal organs are nearly of normal size; the meningitis has disappeared without leaving a trace. But the child is in a condition of the extremest emaciation. Though sixteen months old, it cannot even hold up its head. There is no sign of teeth in the gums. The skin hangs in folds and wrinkles; the subcutaneous fatty tissue seems entirely absent. The face is wizened, and has the characteristic "old man" appearance in a most marked degree. The fontanelles are as wide open as at birth, and the bones of the skull override at the sutures. But the child is nursing well, sleeps well, and cries much less than formerly.

There are one or two points of especial interest in connection with this case. The mother, as you see, is a florid, robust, and perfectly healthy woman, and she has never during the entire time that she has been under observation showed the slightest sign of disease. There is no history of genital lesion, eruption, or other phenomenon of syphilis during the months that she was carrying the child or during the period succeeding delivery. On the other hand, her husband had something the matter with him some two or three years ago. She is evidently not of a very inquisitive disposition, and she cannot or will not tell us anything of the nature of his sickness. It is safe to assume, however, that he was infected, although he did not directly infect her. He procreated a syphilitic infant, and the mother is an excellent exemplification of what is known as "Colles's Law." She has been called a "protected victim" of the disease. She has been indirectly infected, though the only evidences of this are the facts that she has borne a syphilitic infant, and that she has not contracted primary syphilis from it or from her husband. The latter fact is proof positive of infection; for months this woman has nursed a child with a mouth full of contagious lesions, and she has not had a chancre of the nipple.

The second point is in respect to the nourishing of these syphilitic infants. I am decidedly of the opinion that nursing by the mother is the method to be employed in every case where that is possible. If the mother is dead, or the amount or quality of the milk is such as to make it absolutely impossible to sustain the child,

FIG. 2.—Hereditary syphilis.

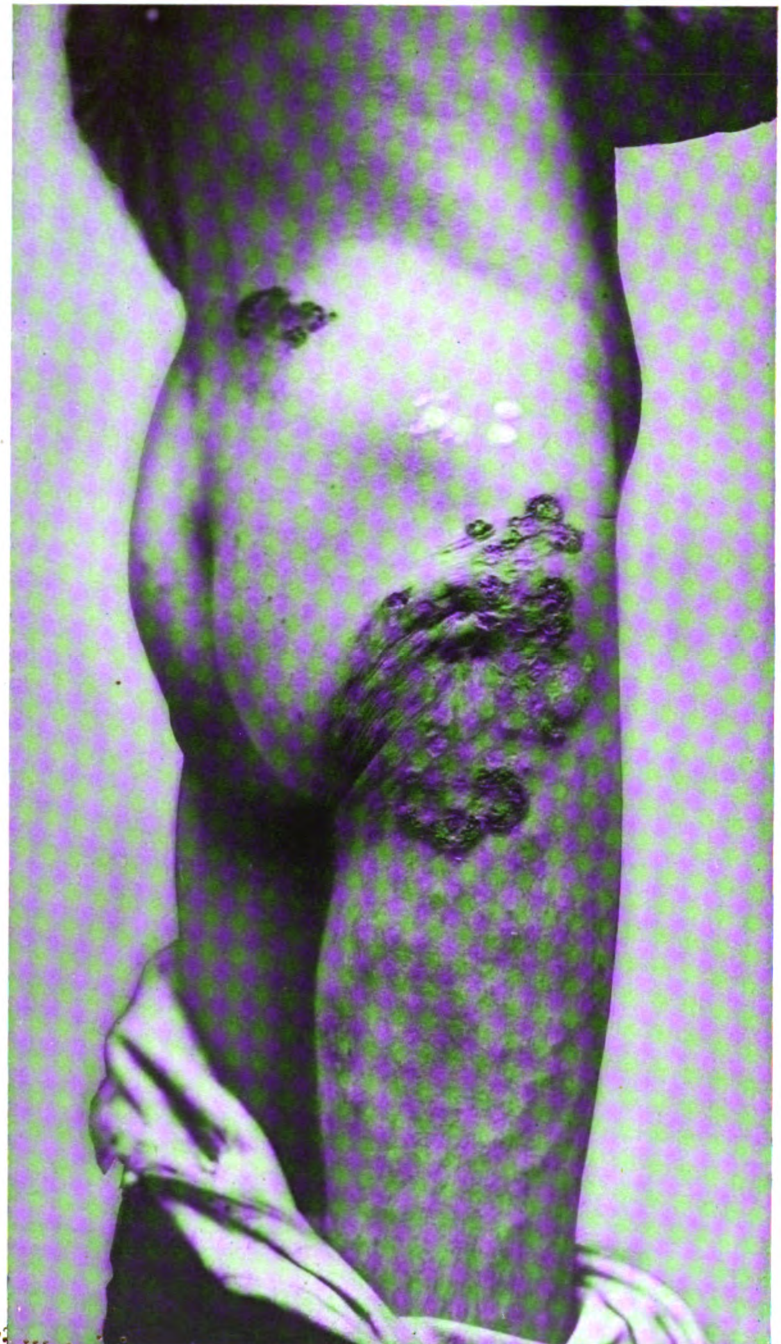

Fig. 3.—Tertiary lesion of syphilis.

resort must be had to artificial feeding. Wet-nursing is, of course, out of the question, unless one should happen to have on hand a nurse who has positively had syphilis. The mother herself is almost invariably protected, and even poor mother's-milk is better in these cases than artificial substitutes. We are too prone to regard the marasmus which accompanies these systemic infections as due to some fault in the lacteal secretion. In this case Professor Winters, who was kind enough to see it, advised a trial of modified milk; but though used in various combinations, it proved to be entirely unsuitable. I shall leave the child at the breast as long as possible.

In spite of the infant's appearance, I now regard the prognosis as good. The iodide of iron is my favorite remedy in such cases, containing as it does iodine and the ferruginous tonic, both of which are indicated. We will put the child upon grain doses of the salt three times daily.

Three months later the improvement was so great that the child was hardly recognizable. The skin was still loose and flabby, but much subcutaneous fat had been laid on. The face was much fuller, though the nose was still sharp and the cheek-bones prominent. The child could sit up, and the two upper incisors had appeared through the gum. All the functions were normal, and the child was practically recovered.

The last patient to be presented is one of those chronic sufferers from syphilitic infection who are commoner in our community than is generally supposed. He is a man who has passed through a severe form of the disease, lasting for many years, practically untreated. From time to time, when the burden of his physical troubles became too great to bear, he would pay a few visits to some dispensary or hospital to get temporary relief. But he has never undergone sustained or systematic treatment, and he does not want it even now. The chances are that he will go on suffering from outbreaks of tertiary disease until he dies, and his death will probably be due to syphilitic disease of the vessels, nerve centres, or other important organs.

At the present moment there is an exacerbation of his disease, and the evidence upon his skin shows that he has passed through

many such. His trunk and limbs are covered with scars of varying age and size. In shape they are all circular or crescentic. Some are depressed, stellate, and dead white, evidently many years old. Others, more recent, are still dark brown and pigmented. The lesion for which he seeks relief is situated upon his right hip, and consists of a series of ulcerations of circular, semicircular, or crescentic shape massed in that region. It is an excellent example of the very late serpiginous syphiloderm.

Of course we shall not be able to institute and carry out the treatment that a case like this ought to have. Believing as we do that the difference between a mild and short and a severe and long-drawn-out syphilis is due to individual conditions and dependent essentially on the patient's general health, the virus being the same in all cases, hygienic and tonic measures, good food, fresh air, proper baths, and rest are more important than drugs in a case like this. The active germs of the disease have long since disappeared from this patient's body; he can no longer transmit syphilis either directly or through his semen. He is suffering from sequelæ which appear partly because he has never had proper systematic treatment and partly also because he is careless, shiftless, improperly nourished and housed, and a drinker. Radical treatment is entirely out of the question. And he does not want it. He asks to be relieved from this extensive ulceration. He does not mind small sores at all, as he says he has had them off and on for years. We will therefore simply prescribe iodide of potassium with a little mercury, give him some blue ointment for local application, and send him off. He will come here a few times until the ulcerations are about half healed, and then will disappear, to reappear again in a few weeks or months at some other free clinic, and form another item in the statistics of tertiarism in the specific disease.

SYPHILITIC HEPATITIS, ASCITES, JAUNDICE.

BY GEORGE L. PEABODY, M.D.,

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This man is an Italian, thirty-two years of age, and unmarried. He was admitted to the New York Hospital September 25. His family history is negative. He had a chancre five years ago, but previous to this and subsequently the history obtained is not clear. He has been a hard drinker for twenty years, consuming wine and beer chiefly. About one year ago he became very weak and often vomited. About January 1 his abdomen began to enlarge, and has continued to increase in size ever since. Previously there was no dyspnœa or œdema. He has always had a little tendency to nose-bleed; sometimes epistaxis occurred every day. There were no urinary features. During the past four months he has been somewhat jaundiced. His appetite is good and his bowels are regular. His chief complaint is the distention of his abdomen. His temperature and respirations are normal, and the pulse 92. Upon admission he was poorly nourished, and he had sunken eyes, with the hepatic facies. There was jaundice of the skin and conjunctivæ, a little more marked than now. The tongue was moist, coated in the middle, and red at the edges. The body was covered with pigmented areas and small scabs. Not to take up too much of your time, I will say that there is evidence of a small amount of fluid in both pleural cavities. The liver dulness began in the fourth intercostal space and extended three and a half inches below the free border. The spleen can be felt three inches below the free border of the ribs. The superficial veins are prominent. The extremities show lesions of tertiary syphilis, and are somewhat œdematous. Over the inner aspect of the left tibia I find a distinct hard thickening of that bone, accompanied by pain,—a periostitis. There is some swell-

ing of the long bones, notably the ends of the tibia and the fibula above the ankle-joint on the right side. On the left side the end of the tibia is swollen. I find, too, on the left hand a soft fluctuating swelling, which has opened and discharged a semi-fluid material, and which has left a false point of motion at the metacarpal bone; this is probably a gumma which has almost entirely disappeared under mixed treatment.

The abdomen is distended. The question now is, What is the cause of the swelling? From the history we would say that the fluid was in the peritoneum. How do we know that it is not fat in the abdominal wall that causes this distention? We can prove that it is not fat by simple inspection. We never find fat with a protuberant umbilicus in the abdominal wall in such quantities. The umbilicus is always retracted and forms a deep depression there because the tissues are tense. Fluid pushes out the umbilicus; fat never does. Also, notice the enormous pigmented spots and scabs; these are due to excoriations produced by scratching, caused by the itching. There are no pediculi. Itching of the skin may sometimes occur in cirrhosis of the liver; it is not due to the distention, because it is not a common symptom in accumulation of fluid in the abdomen. I suppose it is a neurotic disturbance of the same nature as the itching of the skin that is caused by jaundice. We have as an evidence of disturbance of the portal circulation this condition in the abdomen. When fluid accumulates in the abdomen it is very likely to be due to interference with the portal circulation. We have two very common causative factors in cases of cirrhosis of the liver,—namely, alcohol and syphilis. The question now arises as to which of these factors is the cause of the disease. This is, of course, very important to know from the point of view of prognosis and treatment. If it is an alcoholic cirrhosis, the prognosis is bad and the treatment is symptomatic. If it is due to syphilis, the prognosis is better and the treatment entirely different. Now, syphilitic hepatitis is a disease that occurs in two forms: we may get a diffuse interstitial hepatitis which does not differ in its symptoms from the ordinary alcoholic hepatitis; we may, on the other hand, get a large syphilitic gumma on the surface of the liver producing serious symptoms, and most amenable to treatment. This man has been tapped on two occasions. The distinct depression with rigid periphery felt near the

lower border of the liver suggests cicatricial tissue of a gumma, and so justifies the inference that it is a syphilitic lesion. He has not had symptoms of portal obstruction, as shown by disturbances of the bowels. In syphilitic disease one rather expects to find patients with good appetites and less disturbance of circulation than is found in alcoholic cirrhosis. This man's appetite is good, and there are no gastric symptoms of consequence. He has no diarrhœa, nor has he any marked bowel symptoms. But he has an abdominal distention which troubles him very much; it gives him pain and interferes with his respiration; so I have decided to tap him in order to relieve these symptoms. Before tapping this man we should first learn if this is fluid. In the dorsal position the flanks are dull, while the umbilical and epigastric regions are tympanitic when percussed. The area of resonance may have an oval outline. When the patient turns on the opposite side, the fluid gravitates to the dependent part, and the uppermost flank becomes tympanitic. On percussion you can both feel and see the fluid wave; there is a distinct vibration. So there is no question about having to deal with fluid in the abdominal cavity.

In tapping, we should select a place between the symphysis pubis and the umbilicus. Before making a puncture we should know that the bladder has been emptied. The next matter of importance relates to cleanliness. Long before the days of antisepsis I used to tap the abdominal cavity frequently; I kept the skin clean, and I never saw infection follow when the ordinary measures of cleanliness were observed. Do not use a very small needle. Use the trocar and canula, and you will then permit the fluid to flow out freely; in some instances the patient feels very lax, and he is therefore bound tightly with a binder; in this man we will use a many-tailed bandage, although I do not think that there is much benefit to be derived from its employment, and, as a rule, I do not use it. I give support by the use of the ordinary binder. The skin of the abdomen is very sensitive, so we will now use a little cocaine; this should always be employed in sensitive patients. A skin incision is made in the median line with the scalpel. One-half an inch incision is long enough. Then take the trocar and canula in the right hand, grasping it firmly, and measure off the distance that you wish to puncture, and drive it in; do not enter slowly. Protect it by the thumb, and so make an artificial

hilt, and then push it in quickly. The pain in these operations is trivial.

(Twenty minutes later.) In dressing this wound I simply use a piece of iodoform gauze and adhesive plaster; any leakage that takes place will do no harm. Now, please notice the difference in the size of this man's abdomen. His pulse is excellent. He is not at all damaged by the severity of our work. I can now easily feel the free edge of the liver on a level with the umbilicus. The surface of this organ is perfectly smooth; there is a depression near the free border of the liver, which has certainly diminished in size. He has been under the mixed treatment with inunctions and iodides internally. This is a case of cirrhosis, probably alcoholic with possibly a gumma on the surface of the liver, appearing in a patient suffering from syphilis in the tertiary stage. To-day the waist measurement was forty and one-half inches; it is now thirty inches. Fourteen quarts of fluid have been taken away to-day.

(One week later.) Before tapping this man last week he measured forty and one-half inches; after tapping, he measured thirty inches. That night he slept well,—over five hours,—under the administration of chloralamid. The abdomen increased in size, so that the next day it measured thirty-three and one-half inches, and it is steadily increasing, the fluid rapidly accumulating. It now measures thirty-four and one-half inches. Twenty-four ounces of urine are passed daily. His bowels are free. On account of the syphilitic history he is getting potassium iodide.

(Two weeks later.) The Italian whom we tapped three weeks ago did well. He had well-developed syphilis, showing itself in a periostitis and a superficial gumma. He had ascites with a large liver and, apparently, gumma on the surface of the liver. Under the mixed treatment the gumma on the surface of the liver became less. After tapping he improved, no longer suffering from the pressure-effects in the abdomen. He was up and went home on Thanksgiving Day. He returned, but two days ago he eloped.

SYPHILIS OF THE NERVOUS SYSTEM.

CLINICAL LECTURE DELIVERED AT THE NEW YORK SKIN AND CANCER HOSPITAL.

BY EDWARD D. FISHER, M.D.,

Member of the Kings County Medical Society, of the New York State Medical Society, of the New York Academy of Medicine, of the New York Pathological Society, and of the New York Neurological Society; Physician to the Mutual Aid Association; Attending Physician to the Hospital for Nervous Diseases.

GENTLEMEN,—Dr. Bulkley has been kind enough to let me show you a few cases presenting the latest lesions in diseases of the nervous system due to syphilis; rather those relating to the latest stages of syphilis. Some of the commonest effects of syphilis are shown in three or four well-marked diseases, such as general paresis, general paralysis of the insane, locomotor ataxia, and various mixed spinal cord diseases. In almost all instances we find that the disorders due to secondary changes from syphilis affect the arterial supply either in the brain or spinal cord. The cause of both locomotor ataxia and general paralysis of the insane can be traced to disease of the blood-vessels. In locomotor ataxia practically one of the most marked symptoms is the change in the eyes.

LOCOMOTOR ATAXIA.

CASE I.—This man presents among the ordinary symptoms of locomotor ataxia the Romberg symptom,—*i. e.,* unsteadiness in standing with the feet together, with or without the eyes closed. In walking there is the same characteristic,—unsteadiness. The reflexes are absent. This patient has a history of specific disease of eight years' standing. That is the time usually required for these symptoms to develop, although this man states that he has had them about seven years. The pains are like those of rheumatism. It is eight years since he had the chancre. In locomotor ataxia the pathological changes are to be found in the posterior nerve roots and the spinal ganglia, and within the posterior fibres

and column or tract of the spinal cord. In addition there are many cranial nerve lesions, as, for instance, third nerve paralysis. In this case there is the dilated pupil with the characteristic Romberg symptom. There may be ptosis and strabismus of various forms. The pupils are interesting here in showing inequality and in being dilated,—the left one being larger than the right. This man's pupils are characteristic of tabes.

Case II.—This is another instance of locomotor ataxia due to syphilis, as in the last case. Probably the majority of cases of tabes,—sixty per cent.,—are due to syphilis; this is not so large a proportion as has been stated. Some authorities assert that eighty or ninety per cent. of cases are due to this cause. I should say that sixty per cent. would cover the number of cases of locomotor ataxia due to syphilis. In this man we find similar symptoms,—inability to stand with the eyes closed, unsteadiness in walking, beginning general ataxia, inequality of the pupils (the right being larger than the left), and a failure to respond to light. This is a progressive disease. There are two symptoms in locomotor ataxia that make the diagnosis positive,—*i.e.*, lost reflexes and pupillary changes. The pupils fail to respond to light; they may be contracted, dilated, or unequal. Loss of reflexes alone is not sufficient to establish the diagnosis of this disease. The eye symptoms are most important. When the Argyll-Robertson pupil is present you can count upon it that in the course of time symptoms of locomotor ataxia will manifest themselves.

COMBINED SCLEROSIS OF THE SPINAL CORD.

Case III.—In the short time that I have to speak to you I shall endeavor to confine myself to the changes in the eyes. Here is an instance in which we get a history of syphilis; but the patient has not locomotor ataxia, but a mixed spinal cord disease,—*i.e.*, a combined sclerosis which commenced like a myelitis. There are loss of power in the extremities, loss of sensation, and loss of control over the bladder and rectum; but this has never been total. As he began to get around other symptoms besides the paralytic ones showed themselves,—those of ataxia. Instead of lost reflexes he has exaggerated reflexes, as knee-jerk. There is considerable knee-jerk and ankle-clonus. In this case, therefore, we have a combined sclerosis, not only of the posterior, but also

of the lateral columns. He has the characteristic pupils found in locomotor ataxia; they are the pin-hole pupils like those present in opium-poisoning. There is the same reaction to light and accommodation.

SYPHILITIC HEMIPLEGIA.

Case IV.—Perhaps one of the most important conditions to deal with among the latest manifestations of syphilis is hemiplegia or thrombosis. In syphilitic hemiplegia, or thrombosis, one of the characteristic symptoms is the gradual onset. The patient does not lose consciousness, but there are an interference with speech, a numbness, and some loss of power in the hands. The patient may have another attack within three to six months; or similar symptoms may develop on the opposite side of the body. A multiple hemiplegia is almost pathognomonic of cerebral syphilis. This man gives a history of having had syphilis twenty-nine years ago. At that time he was put through the regular course of treatment. He was under the care of Dr. Taylor and other physicians. He took five hundred grains of potassium iodide a day continuously for a time. He has been under inunction treatment. All this is important, for such treatment should be capable of preventing the late manifestations of the disease. Unfortunately, the most rigid treatment that can be enforced will not allow one to say that the later symptoms will not appear, as in this man. He did not lose consciousness at the time of attack four months ago. I found some interference with speech, limited to one side. The face was flattened on one side, and there was some weakness on one side of the body, and the tongue was deflected to the right. All these symptoms cleared up completely at the end of two weeks, when he had a second attack. Now what happened? There was a thickening of the walls of the blood-vessels, an endarteritis, a gummatous infiltration of the coats of the vessels. That can be seen in the fundus of the eye. It is syphilitic in character. An artery became occluded by increase of this condition and the patient had a gradual, slow paralysis following occlusion of the vessels, probably in the region of the internal capsule. In two weeks' time there was a recurrence. It was hoped that under inunctions the obstruction would be absorbed. That is possible. These cases are interesting, especially in reference to the later manifestations

of syphilis, hemiplegia due to thrombosis, locomotor ataxia, and the various forms of combined sclerosis, general paralysis of the insane, etc. There is about the same proportion of cases of general paralysis of the insane due to syphilis as in locomotor ataxia. I would not say that every case of locomotor ataxia or paralysis of the insane was due to syphilis. In syphilis the arterial changes are the basis of most of the secondary symptoms present.

Therapeutics

DIGITALIS IN CHILDREN; SODIUM NITRITE IN CARDIAC FIBROSIS; PROGRESSIVE CHRONIC ENDOCARDITIS.

CLINICAL LECTURE DELIVERED AT THE NEW YORK POLYCLINIC HOSPITAL AND SCHOOL FOR GRADUATES IN MEDICINE.

BY CHARLES ROSS JACKSON, M.D.,
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Gentlemen,—We have to-day some heart cases which we shall examine and discuss with special reference to their treatment and its results.

Case I.—This girl of eleven years first came under observation about two months ago. She had had a severe attack of scarlet fever some five years previously. In other respects her history was negative. Upon examination we found that her heart was enormously enlarged, the apex-beat being in the anterior axillary line in the seventh space, three inches outside and about two inches below its normal position. The pulse was between one hundred and ten and one hundred and twenty, feeble, irregular, and of low tension. The apex-beat was diffuse and the heart-sounds distinctly those of dilatation, the first sound being accompanied by a very faint murmur referable to mitral regurgitation. This murmur was systolic in time at the apex and in the axilla. No positive murmurs could be made out elsewhere. A most noticeable thrill was present at the apex, but its time could not be satisfactorily determined. The collapsing quality of the pulse and the brachial tap, —a peculiar instantaneous tapping sensation elicited by placing the thumb vertically over the brachial artery, the patient's arm being extended,—together pointed to a probable aortic regurgita-

tion. This was considered the more likely because of the extreme enlargement of the heart, an enlargement of unusual proportions and not attributable to simple mitral regurgitation. The patient was cyanosed, her respirations were forty-six to the minute, and there was distinct evidence of pulmonary œdema in both lower lobes. The urine was scant and the legs were œdematous below the knees.

In this, as in all forms of heart lesion, the patient requires a nutritious diet, and the blood must be made as rich as possible by the administration of iron and sometimes of arsenic. Laxatives should be used, though never to the point of causing weakness. An occasional mild calomel purge seems to act favorably in the re-adjustment of tension. In such a case as this, however, the treatment of the heart itself must be direct and vigorous. Rest and powerful heart stimulation were ordered. Digitalis, beginning with four drops of the tincture three times a day, was given. Slight improvement followed; but this did not become progressive until the dose was increased to ten drops four times a day. Some observers claim that digitalis is of little value in the treatment of cardiac incompetence in children. They insist that the drug should always be given to them in very small doses, even to the fraction of a minim; that it often increases rather than diminishes the rapidity of the heart action; and that it is generally unreliable. I acknowledge that in small doses it frequently does quicken the pulse-rate, but this is no evidence of toxic action or of the inability of digitalis to do good; it simply means that the therapeutic dose has not been determined. This case did not improve much on small doses; the pulse became stronger but decidedly more rapid, rising frequently to one hundred and twenty-six. But the heart was not *under* digitalis; it was merely stimulated by the dose. Four days after the increase to ten drops the pulse was ninety and of higher tension. Besides this the dyspnœa was decidedly relieved, the urine was doubled in quantity, and the cyanosis was less. To stop at four drops would have been disadvantageous to the child's chances. Fortunately, the gastro-intestinal tract has been tolerant of the drug. For the past few weeks the dose has been reduced to fifteen drops daily, compensation having been re-established.

To-day we find the patient very much improved; the respira-

tions are twenty-two, and the heart action is vigorous and regular at ninety. Physical examination reveals a much stronger apex-beat, an improved first sound, and a very pronounced mitral systolic murmur audible even over the left axillary region and posteriorly. There is also a soft diastolic aortic murmur most audible over the sternum and to the left of the ensiform cartilage, but also at the apex. The collapsing quality of the pulse is well marked, and the diagnosis of aortic regurgitation is confirmed. The thrill at the apex is very pronounced, and is both systolic and diastolic; the former doubtless dependent upon the mitral leakage; the latter, on vibrations generated by the diastolic downrush from the aorta during the period of leakage at the aortic valve.

In aortic lesions uncomplicated by mitral regurgitation digitalis must be used cautiously, care being taken not to lower the heart-rate much below eighty, in order to prevent overfilling and diastolic arrest. But in a case like the one before us, in which the aortic lesion is complicated by mitral leakage, the experience of clinicians is that the danger is less, although it is difficult to understand the explanation sometimes offered,—that the mitral insufficiency furnishes an outlet from the left ventricle for blood coming from the aorta during diastole, since such blood must be necessarily impeded in its possible exit through that outlet by the simultaneous influx from the left auricle during diastole. Be that as it may, digitalis certainly greatly benefits many of these cases. The explanation lies, to my mind, in the improvement of the tone and power of the right ventricle and the consequent diminution of venous engorgement in the lungs and the general venous system, an effect which it cannot have in simple aortic regurgitation when the mitral valves are still intact, the symptoms of disease then being limited to the results of change in the blood-supply of the aortic system only.

In the case of this child digitalis has been discontinued for but four days in two months; the heart-changes are so great that comparatively large quantities are necessary to produce the desired results. Experience has taught me that there are two important points to be considered when giving digitalis: first, the power of the myocardium to react to stimulation; and, secondly, the size of the heart, the nature of its lesions, and the condition of the arterial tension. Small people with large hearts, and grave lesions with

low arterial tension, frequently need as much of the drug to affect the cardiac rhythm as do large people with lesser lesions and higher tension. Of course, we must always be on the alert for toxic symptoms when administering digitalis; remembering, however, that gastro-intestinal disorders—even purging and vomiting—will sometimes occur as a purely local symptom of irritation even when small doses are taken, the heart and nervous system being uninfluenced by the drug. The future treatment of this case will consist chiefly in the continued use of digitalis. Should the stomach and bowels become intolerant of it we must determine whether it is acting as a systemic poison or merely as a local irritant. If the latter, it may be given by the rectum combined with a few drops of the tincture of opium and a saline solution. Many cases of venous stasis of the stomach from cardiac insufficiency refuse digitalis, and are given up. The colonic method in such instances is a valuable alternative, and will sometimes save the patient. Should it fail or be impracticable, we still have digitalin, which may be given either by the stomach or hypodermically. If by either of these methods we can once secure the therapeutic action of the drug, the cardiac compensation will be re-established, the venous engorgement of the stomach and intestines will cease, and the drug will again be tolerated. In this case, however, a dose of fifteen drops of the tincture per day will probably be taken without irritation for an indefinite period. As a substitute for digitalis, the tincture of strophanthus, in three to eight drop doses, will probably suffice to maintain compensation for a while. If at any time the pulse-tension becomes too high, judicious use of the sodium nitrite twice daily will diminish arterial resistance and permit better systemic nutrition.

We have in this case transformed a heart with predominant dilatation into a well-compensating one; but it is safe to predict that at no distant date another attack of excessive dilatation will occur regardless of treatment. Œdema will become noticeable, venous stasis will prevent absorption of the remedies, and the heart will refuse to respond to even the most heroic measures. The extensive lesions existing in this case and the already very large size of the heart render the hope of further compensatory growth but slight. The approach of puberty is also opposed to the chances of more than three or four years of life. In the patient's favor is the comparatively healthy condition of the myocardium, as proved by

its ability to react to stimulation and its growth. The existence of aortic incompetence makes it certain that systemic nutrition will soon be impaired to a marked degree, and presents the ever-present possibility of fatal syncope, etc.

Although we have had evidences of a giving way of the tricuspid valve before treatment, the leakage there has been diminished as a result of the improved muscular tone of the right side of the heart. It is when the auriculo-ventricular orifice becomes stretched to such a degree that regurgitation is permanent that we approach the final stages; provided, of course, that aortic regurgitation has not already hastened the issue.

Scarlatinous endocarditis involving the mitral and later the aortic valve is frequently met in this clinic.

Case II.—This patient, a man fifty-seven years old, came to us six months ago, complaining of dyspnœa and headaches. His history was negative, except that he had been a hearty eater all his life. Examination showed that his kidneys were healthy, but the heart and arterial system were found to be much affected. His pulse was slow and intermittent, about sixty-six and of very high tension. The arteries were thickened and easily palpable. Comparison of the pulse with the systole of the heart showed that when the beats intermitted at the wrist there was frequently a first sound of the heart audible at the apex, showing an incomplete systole, a condition not infrequently present when the left ventricle is working against very high arterial tension and is about to break down or has already done so under the excessive work. We easily determined that there were eighty ventricular contractions per minute; those which caused a radial pulse were fairly strong, but the apex-beat never was palpable or visible. It was located by auscultation in the fifth space, one inch outside the nipple-line. The area of absolute dulness extended to the apex, inward to the right edge of the sternum, and upward to the third space. In addition to the enlargement of the heart a mitral regurgitant murmur and a ringing aortic second sound were audible with each complete systole. The condition is one of cardio-arterio-fibrosis, and illustrates a large class of cases frequently seen in this clinic. The regurgitant murmur is probably due to a stretching of the mitral orifice dependent on the excessive enlargement and dilatation of the left ventricle. The aortic valves have not been

sufficiently involved as yet to lead to impairment of their function, though they frequently are so affected when fibrotic changes are present elsewhere. The general hypertrophy of the tunica media of the arteries is accompanied by an increase in the muscular layer of the heart, which is thereby enabled to overcome to a certain point the increasing tension developing in the arterial tree. Beyond this point degeneration, usually of a fibrotic type, occurs; it is preceded by changes in the coronary arteries, which, of course, share in the general pathologic process. The heart muscle then becomes unable to equalize the circulation, and active cardiac symptoms, such as dyspnœa, become manifest.

When first seen this man was treated with nitroglycerin for its effect on the tension, and his heart was stimulated with strychnine. A change was later made from nitroglycerin to sodium nitrite, two grains three times a day, as the former, even in small doses, aggravated the headaches, a not infrequent effect. The strychnine was discontinued; strophanthus and nux vomica in eight-drop doses were given instead; and upon this treatment he has been kept for several months. The severe headaches which caused him so much distress at the time of his admission have entirely left him; his pulse is larger, softer, and much less intermittent; his general condition is greatly improved, and the dyspnœa is absent. Laxatives have been given and his diet regulated; his improvement, however, is mainly due to the reduction of tension in the vascular system by the nitrite, which has allowed of the recovery of cardiac compensation under mild stimulation. These cases, in my experience, are most benefited by sodium nitrite. Nitroglycerin, even when given for headaches of high tension, will sometimes act in an unfavorable manner. The effect of sodium nitrite is much more permanent and gentle, and it rarely causes headache. In many cases the heart needs no stimulation; simply a chance to work to less disadvantage.

The cause of this very interesting disease is sometimes syphilis; but often lead and other toxic agents such as are found in the so-called gouty condition. Some hold that chronic auto-intoxication from digestive disturbances is responsible for the disease. Under the effect of the toxines the vasa vasorum succumb first, they being the more delicate; the arteries they supply then become affected. As Allbutt suggests, the poison may so irritate the vasa vasorum as

to bring about inflammatory changes in these vessels which lead to a replacement fibrosis in the arteries which they supply. The controlling causes are indistinctly understood; but it is well established that wear and tear, strain, and prolonged overwork are important factors, and these co-operating with toxines destructive to the delicate structure of the vasa vasorum are doubtless responsible for the condition.

The moderate action of the vasodilators when long continued not only diminishes resistance to the emptying of the ventricle, but increases the nutrition of the arteries themselves and also that of the myocardium through the coronaries, which, of course, participate in the arterial dilatation. In giving these drugs one must be careful not to unlock the arterioles sufficiently to cause the heart to act under too little resistance, thus giving rise to a condition of tachycardia, much to be avoided. In ordinary cases under this treatment the pulse quickens a little, perhaps ten beats to the minute, the increase in rate depending largely upon the amount of the nitrite administered. The effect of the drug in the present instance has been to bring the pulse more nearly in correspondence with the frequency of the heart contractions. These are only slightly accelerated, but the increased strength of each individual systole makes it manifest at the wrist, thereby considerably adding to the rate of the pulse, which, as you remember, was previously intermittent. The heart action itself has not been much accelerated, owing to the strophanthus, which somewhat affects the quickening effect of the nitrite. The most successful method of administering the vasodilators in many cases is in a proper combination with digitalis or strophanthus, thereby obtaining the effect desired on the arterial system without increasing the rapidity of the heart action to an improper degree. While not always in accordance with the theoretical action of these drugs, practically and clinically the results are astonishingly good. When the kidneys are involved the high tension would seem necessary for good circulation in these organs. Judicious use of the vasodilators has never, in my experience, been followed by a diminution in the quantity of urine passed, as has been claimed by some observers. This man says he is so much improved that he can again engage in active pursuits. The first sound of his heart is more booming than we have ever heard it, and there is now no difficulty in locating the

apex at the nipple line by palpation. These cases, if taken in time and properly watched, are far more amenable to treatment than before the days of the employment of the vasodilators. But, of course, the disease *per se* being a progressive one, they are, strictly speaking, incurable. A line of treatment which retards its advance or ameliorates its ill effects may, I think, be rightfully regarded as of much value. Untreated, this case would long ere this have shown a complete cardiac breakdown, and in all probability have already reached its termination, whereas now the outlook is certainly hopeful, at least for a period of years.

The potassium and sodium iodides are frequently used in arterial disease with much the same effect as the nitrites; in fact, Balfour uses them as a corrective to digitalis in these cases of senile heart. Many persons, however, have such idiosyncrasies against the iodides that personally I prefer the nitrites in most clinical cases. Erythrol tetranitrate is valuable, its effect being quite persistent. Persons who feel the stronger nitrites even when taken in small doses usually bear the nitrite of ethyl well. This may be given as freshly prepared sweet spirits of nitre in combination or alone in small doses, and is usually especially advantageous in cases of high tension with a gouty history on account of its value as a mild diaphoretic and diuretic and as a gastric stimulant.

Case III.—This man of twenty-one years came to us one year ago complaining of attacks of substernal pain, and of dyspnœa, headache, constipation, and inability to work. He gave a history of articular rheumatism three years previously, and said that he had for several months been losing appetite and strength. A careful examination showed the heart to be the organ primarily at fault. It was considerably enlarged, the apex in the sixth space at the nipple line, and a loud systolic murmur heard at this point and transmitted to the angle of the scapula permitted a diagnosis of mitral regurgitation. No other murmurs were audible, and there was at that time no evidence of mitral obstruction, presystolic thrill and murmur being absent. There was, however, and always has been, marked anæmia, as evidenced by the venous hum and the appearance of the patient. The origin of the murmur at the mitral orifice was regarded as organic and dependent on an endocarditis. A dynamic murmur due indirectly to anæmia would not have been accompanied by such enlargement of the left ventricle. The pres-

ence of subcrepitant râles at both lung bases also aided in a correct interpretation of the condition. At this period his pulse was of fair volume, somewhat irregular and rapid,—about one hundred and ten. The patient was treated with large doses of iron in various forms, mild laxatives, and fair-sized doses of digitalis, under which his condition was much improved. His heart action became slower and much stronger, and his general appearance was decidedly better. The venous hum in his neck became much less audible and the outlook was very favorable until suddenly he developed slight fever with occasional chills and began to fail rapidly. Malaria and tuberculosis were easily excluded, and careful observation showed that a presystolic mitral murmur and thrill were developing. From week to week these have become more apparent; the fever and chills, which were doubtless due to a progressive endocarditis, are no longer present. Clinically we often see these heart lesions progress rapidly from time to time and then undergo a period of quiescence. The exacerbations of more or less active processes in the endocardium, being accompanied by slight fever and occasional chills, simulate for a time a mild ague, and have given rise to the name of *malarial form of endocarditis*. Aided by the blood examination, we soon cleared up the matter and were enabled properly to localize the process.

Now you will notice that this young man is in anything but good condition. While his heart is acting slowly at about seventy under the influence of digitalis, we still find that his pulse is very feeble and small. Although there is a fair cardiac impulse, it is chiefly due to the enlarged right ventricle. The left ventricle is now very poorly supplied with blood, owing to the progressive mitral stenosis, and in consequence the general aortic system is suffering much from lack of nutrition. The mitral regurgitant murmur is still present, but is much diminished in tone. A double lesion like this at the mitral orifice is often accompanied by an enlarged left ventricle, proving that the regurgitation antedates the stenosis. As the latter increases we not uncommonly find no further increase in the size of the ventricle on account of the diminished blood-supply. This is the case in the patient before us, for the apex is now where it was a year ago, despite the fact that the condition of the heart is much worse. His lungs at times show very marked signs of œdema, and he occasionally suffers from hemorrhages, a

direct consequence of the venous stasis and great engorgement in the minor circulation. He now complains of occasional giddiness and weakness and shaking of the knees on exercise in consequence of the impoverished blood-supply to the brain from the poorly filled left ventricle and aortic system. Beside this matter of grave concern we are also confronted by a very serious condition of the right ventricle. It is much enlarged, as percussion shows, and the constant strain of the effort to force the blood through the lungs has led to its dilatation and to sequential giving way of the tricuspid orifice, as you see by the systolic venous pulse in the neck. His liver is considerably larger than normal, and inasmuch as his heart action is kept up to its present standard only by digitalis the condition is grave. In these cases hemorrhages from the lungs are rarely severe, and, aside from shock, are rather favorable than otherwise, as they relieve the tension in the right ventricle. Myocardial weakness is here sure to be progressive, as the mitral stenosis not only throws too much work on the right ventricle, but it so interferes with the blood-supply to the left that the outflow into the aorta is small and the tension therein so diminished that the coronary arteries are not properly filled, and the heart muscle itself must be in a spanæmic condition. The small, soft pulse evidences the poor arterial supply; but more important than this is the very weak aortic second sound, which is inaudible except over a very limited area to the right of the sternum, and is not transmitted to the heart apex and to the left, as it should be when the valve is closing under fair tension, as in the first stages of mitral obstruction.

The treatment of this case has been and will be unsatisfactory. The administration of blood and general tonics, while indicated, has proved of little value. General venous stasis prevents their absorption, and the general arterial anæmia prevents tissue nourishment. The administration of digitalis has been tolerated, and has improved the patient's condition at times; but the increasing obstruction at the mitral compels a very poor prognosis. Occasionally we have detected reduplication of the second sound so often found with stenosis and dependent upon closure of the pulmonic valve before the aortic. This occurs because the back pressure in the pulmonary circulation is so much greater than normal. This condition is frequently accentuated by digitalis and sometimes interferes with its use in these cases. As this reduplication occurs

when the tension in the lung circulation is high and the right ventricle strong, it is infrequent when the ventricle fails and tricuspid regurgitation is present, the tension in the pulmonic circulation being lower then than before. We still have an occasional presystolic thrill and murmur when the heart is stimulated by exercise, but these will disappear with the failure of the right ventricle to maintain the necessary pressure in the minor circulation. For this patient rest is now essential, but the congested and œdematous lungs will not favor a recumbent position. Bleeding may be called for at a later date and be of some value. Cases of advancing mitral obstruction do not, as a rule, develop much œdema except in the lungs,—life rarely lasts long enough, the scanty blood-supply to the arterial system aiding much in closing the scene. The left ventricle, which in other lesions participates and aids in the circulation, is here incapable of efficient work. It contracts certainly, but on such a small amount of blood that it cannot expel enough to nourish either the heart itself through the coronaries or the general system. Lesions such as this one are, in my experience, the most hopeless of all; even more so than the very rare instances of advanced aortic stenosis with complete breakdown of the mitral and tricuspid valves. In aortic stenosis we do seem to prolong the general nutrition and increase the pulse wave by using nitrites, perhaps because we enlarge the arteries and diminish the resistance ahead, and we always have plenty of blood in the left ventricle. In mitral stenosis the supply to the left ventricle is hopelessly cut off.

RESPIRATORY GYMNASTICS FOR TUBERCULAR PATIENTS.

BY FERNAND LAGRANGE, M.D.,

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Of the various agents for the *hygienic* treatment of tuberculosis there are none of greater importance, particularly when there is only a predisposition to the disease, than those which act on the respiratory functions.

In the hygiene of breathing there are two chief and quite distinct factors. The first is the choice of the air best suited for the patient to breathe; the second, which is almost invariably overlooked, is the *instruction of the patient in the way it should be breathed.*

The importance of the *quality* of the atmospheric air to tubercular patients, or to those who seem likely to develop the disease, is universally recognized, and from it has been deduced the open-air treatment of tuberculosis and the sanatorium principle.

But our task is by no means ended when we have placed our patients in an absolutely pure atmosphere endowed with invigorating properties; we have still to make sure that the conditions exist whereby they will derive the full benefit from the elements of physiological wealth with which they are surrounded.

Atmospheric air is for the human system a *gaseous form of food* as indispensable for nourishing and building up strength as any of the liquid or solid forms of food taken by the stomach. But what use would there be in offering to an exhausted patient the most wholesome and nutritious articles of diet, if he could not consume them through the lack of appetite?

Now the tubercular patient to whom we offer the strong and invigorating air of our sanatoria does not in many cases derive the benefit from it that he might, owing to want of *respiratory appetite.* His condition is one of diminished need of breathing, and this stands directly in the way of his recovery.

We know that one of the most unfortunate conditions present in those predisposed to tuberculosis is that, long before the invasion of the tubercular germs, their lungs have acquired the habit of sluggish and insufficient expansion, the cells of which they are composed opening incompletely and but partially fulfilling their function. It is universally admitted that this insufficient expansion of the pulmonary vesicles is a most important factor in the genesis of the tubercular condition.

A fact bearing upon this point is the frequency with which tuberculosis occurred among deaf-mutes before the introduction of the phonetic method in their education. Articular speech is a powerful agent in promoting respiratory activity. The lungs must alternately fill and empty themselves with energy to produce the current of air that causes the glottis, tongue, and lips to vibrate at each spoken word. In children who do not speak, this form of pulmonary exercise is totally lacking, and they fall into the habit of respiratory inertia (the lungs using only the number of cells required for breathing), so that in learning to produce articular sounds such children have the greatest difficulty in making expiratory efforts sufficiently energetic to cause the organs of phonation to vibrate. That this idiosyncrasy accounts for the predisposition of these children to tuberculosis is shown by the beneficent results derived from teaching them to speak like other people. The phonetic method enables them to make the sounds of speech which they cannot hear, but which they may read on the lips of those around them. This method not only permits these unfortunates to mingle in society, but since its introduction tuberculosis has markedly decreased among them.

The disordered nutrition produced by insufficient breathing is not limited to the pulmonary tissue. Lungs whose breathing coefficient is below the normal do not take in a sufficient volume of air to furnish the blood with the amount of oxygen necessary to restore and nourish the elements of the body to which the blood carries life. This lack of gaseous food, therefore, will produce a state of inanition of the entire body just as serious as that which results from deficiency of solid food and drink. In this way insufficient breathing gives rise to the two conditions most favorable for the development of pulmonary tuberculosis,—decreased power of pulmonary resistance and an impoverished state of the system in general.

Among the causes that lessen the activity of the lungs, the one just mentioned in speaking of deaf-mutes affects only a small part of the population, but there is another cause of respiratory insufficiency which is greatly underrated,—lack of exercise.

Any one can verify the fact that respiratory activity increases with muscular activity; it is impossible to run or walk quickly without immediately increasing the breathing rhythm and the chest expansion. These phenomena are accompanied by a large increase in the amount of air that enters the lungs; it has been shown, for instance, that a man takes into his lungs three times as much air when walking as when in the recumbent position. Muscular exercise therefore has as its immediate consequence an increase in the quantity of oxygen introduced into the blood, whence more active restoration of tissue-waste from the abundant supply of gaseous food. The patient is just as much benefited by this increase in breathing as by increase in liquid or solid food given in over-feeding. In fact, respiratory over-feeding is a more reliable and efficacious tonic than increased food and drink.

Over-feeding in a patient whose appetite is poor often brings on digestive disorders, and has very often to be temporarily discontinued or permanently abandoned; whereas with the gaseous over-feeding produced by increasing the respiration we can count *with certainty* on seeing the demand for air on the part of the lungs become more keen and the patient make use spontaneously of a larger quantity of oxygen.

By increasing gradually each day the respiratory functions, by means of a regular course of pulmonary gymnastics, we increase not only the vitality of the lungs, but their capacity also, and augment their working power. These are the two most valuable results of what is called *training*.

It is easy to prove that the more the lungs are exercised the greater will be their capacity for work; we all know that by daily practising running or hill-climbing, efforts which at first caused shortness of breath after a time give rise to no inconvenience. Laboratory experiments have demonstrated the mechanism of this increased power of breathing: on the one hand the volume of the lung increases, and on the other hand the respiratory movements are effected in slower rhythm and with greater amplitude.

Thus not only is the organ developed, but its function is also per-

fected. At each breath the ribs rise with greater energy and are carried almost to their maximum limit of "play;" it follows, naturally, that the expansion of the lungs, governed by the movements of the ribs, is increased even when at rest.

This greater amount of oxygen inhaled at each breath enables a man in training to breathe more slowly,—ten times a minute instead of twelve or fourteen. Now it is generally admitted by physiologists that quiet and deep breathing is more favorable to the reoxygenation of the blood than short and quick respiration.

But general and simultaneous exercising of all the muscles of the body is not the only form of respiratory gymnastics; and it is fortunate that this is the case, as a great many patients who need respiratory training are not in a condition to exercise their muscles with the vigor necessary to develop their breathing.

We have ascertained by experience that the muscles of the body have to perform a very considerable amount of work in a given time to increase respiratory activity to any appreciable extent. Running and climbing are forms of exercise in which lung activity is very closely associated with that of the muscles; but slow walking on a level, at the pace which many patients cannot exceed, does not noticeably affect the rhythm or extent of the respiratory movements.

The active and more energetic forms of exercise therefore answer very well for those who are able to take part in them; but in the case of weak persons or of patients who have organic lesions the benefit of pulmonary gymnastics of this kind would be obtained at too great a price. Not only would the muscular work required to obtain this respiratory stimulation be liable to produce a condition of exhaustion, but many of the class we have in view in this paper —the tubercular group, whose pulmonary arteries are often infiltrated—would be liable also to rupture of these vessels and to more or less serious subsequent hemorrhage.

No doubt many tubercular patients retain sufficient strength and vitality to obtain the necessary pulmonary gymnastics in an indirect way,—that is, by bringing into exercise their entire muscular system; and when this plan can be adopted without risk there is no doubt that the results will be more satisfactory than those to be expected from the direct and local methods of exercise which I shall explain. It can be said that those of this class of patients

who have neither fever, hæmoptysis, nor profuse sweats, whose nervous system is not exhausted, and who have not lost greatly in weight, will do well to adopt as breathing exercises either Oertel's method of climbing, or open-air sports, even bicycling and rowing, provided these exercises are taken properly and in great moderation. But even in these favorable cases it is advisable to keep well on the safe side of their limit of strength, as these energetic forms of open-air exercise can always be supplemented by the methods of local gymnastics which I am about to describe.

The special movements whereby the lungs may be exercised without very great muscular effort, or over-stimulation of the chief vital functions, have to be looked for in the *gymnastics of the Swedes,*—the methods devised by Ling, and brought to perfection by his successors.

The essential principle of Swedish gymnastics is to limit muscular work to certain well-ascertained and strictly limited groups of muscles at a time. In this way the energy expended is localized and divided up, so that in order that the entire body should benefit by the hygienic effect of the exercise each group of muscles is used *in succession,* instead of a number of groups *at one time,* as is done in most forms of ordinary gymnastics, such as sports or games; the act of rowing, for instance, or any movement on a horizontal bar, being a *synthesis* of a large number of partial muscular efforts.

The Swedish method, which is essentially *analytical,* decomposes each movement, instead of combining a number of them; each muscular group is brought into play by itself, and in this way a very exact local result is obtained instead of a diffuse, general effect.

In the muscular system there are certain groups of muscles closely connected with certain viscera, which, when brought into play, have a direct and important effect on the working of those organs: thus, the muscles with which the chest is covered have a very important part in the mechanical act of respiration. The Swedish method, which aims at systematically bringing into play all the muscles of the body one by one, has naturally taken this important group into consideration, and has devised movements for exercising the muscles of inspiration and expiration without throwing any extra work on the other muscles. In this way forced movements of inspiration and expiration are caused without giving rise

to the imperious need of breath, the thirst for air, which is the essential concomitant of excessive respiratory activity due to the *general* effects of exercise, a form of activity of which I pointed out the risk for patients with impaired pulmonary vessels.

The Swedish breathing exercises cause the patients to amplify their respiratory movements methodically and in order, and have the same tendency to oblige them to take into the chest at each inspiration a larger quantity of air than usual, as have certain other forms of exercise, such as reading aloud, singing, playing upon wind-instruments, etc.

According to this method the simplest form of respiratory gymnastics would be to take a certain number of the amplest and deepest inspirations that the capacity of one's lungs will allow, and to follow each inspiration with a forced expiration to empty the lung as completely as possible. This is, in fact, an excellent way of increasing respiratory activity, and is really the foundation of the Swedish method; all the latter does in addition is to add a certain number of movements, which amplify the result to which the respiratory efforts would be restricted if the subject remained motionless while making them.

There are certain movements and attitudes that facilitate breathing to which patients instinctively resort when troubled with difficulty in breathing. These are utilized by the Swedish method to give more efficacy to systematized respiratory efforts and exercises. While the patient fills his chest with air to the utmost limit the arms are raised vertically, separated, and carried backward; then during expiration they are lowered and brought forward. This is the fundamental process, of which all the Swedish breathing movements are but variations; for these are based on the fact that the action of raising the arms and carrying them outward, when not hindered, and particularly when assisted by a simultaneous voluntary effort of inspiration, raises the ribs upward and outward by means of the muscles which connect the thorax with the arms and shoulders. The bringing into play of these muscles, combined with voluntary inspiratory effort, increases the expansion of the chest to its maximum. The patient who follows this method derives in a state of complete calm all the benefit that a patient in a crisis of dyspnœa would obtain from forced breathing. In this there is a twofold advantage: an immediate one, in that the quantity of

air taken into the chest is increased; and a secondary one, in that the muscles of complementary breathing are exercised, and thereby become better developed and more efficient.

In addition to this, these respiratory gymnastics render the movements of the ribs freer and their range more ample; they rise at each inspiration and fall at each expiration. Both inspiratory and expiratory muscles have consequently less resistance to overcome. The dynamic element of the respiratory act is therefore increased and passive resistance is diminished. When once this habit of breathing is acquired, education in that respect is virtually completed, as the patient continues to breathe with a rhythm which is as easy as it is efficacious, and to take deep and slow breaths.

The habit of deeper breathing has a beneficial influence even upon the structure of the lungs, by obliging parts that are customarily inactive to take part mechanically in the act of respiration. Air cells collapsed from disuse become distended by the air which is drawn in by the vigorous inspiratory act, and regain their normal dimensions. By thus resuming active participation in the pulmonary function the volume of the lungs diminished by disuse is increased, often with the most astonishing rapidity.

As a consequence of this modification in the volume of its contents the chest changes in form. The ribs no longer yielding to atmospheric pressure, the chest measure increases without thickening of the walls of the thorax. This increase in the perimeter of the chest is a measure of the lung expansion.

In forming an accurate estimate of the advantages of respiratory exercises we must be guided not only by the chest measurement, but also by the spirometer, which shows us the maximum air capacity of the chest before and after treatment. It is found that this can sometimes be doubled. Another instrument, the pneumograph, which enables us to demonstrate graphically the form and rhythm of the respiratory movements, shows that breathing is slower and deeper after gymnastic education than before.

Of the methods whereby these most valuable results can be obtained, I have been able to give only a summary. They consist in methodical movements of the arms combined with voluntary inspiration and expiration. The methods which are based on this fundamental principle vary somewhat in their application by the usual

drill of the Swedish gymnasts, and by the machines invented by Zander.

The latter method of respiratory gymnastics is effected by a series of machines designed to produce the maximum dilatation of the chest; some of these call for active and others for passive movements on the patient's part. In addition to dilating the chest, they straighten and strengthen the vertebral column by stimulating the action of the extensor muscles of the vertebræ.

The apparatus for passive respiratory exercises has the advantage of being applicable to the treatment of the most debilitated patients, who can thus have their chests expanded with very little fatigue and with all the attendant benefits of this method.

Such are the resources offered by the Swedish system in the application of respiratory gymnastics to tubercular patients. It will readily be seen that, thanks to the multiplicity of the means that the physician has at his disposal, it is possible to combine exercises that give rise to a general effort with those that limit their effect to a given region, and to use at one time active movements and at another passive, so that there is really no stage of pulmonary tuberculosis to which respiratory gymnastics cannot be applied.

THE TREATMENT OF TYPHOID FEVER IN CHILDHOOD, PARTICULARLY BY COLD BATHS.

CLINICAL LECTURE DELIVERED AT THE CHILDREN'S HOSPITAL, PARIS.

BY A. B. MARFAN, M.D.,
Assistant Professor, and Physician to the Paris Hospitals.

Gentlemen,—It has probably come to your knowledge that a discussion concerning the treatment of typhoid fever has recently taken place in one of the learned societies of this city. My object in taking part in this discussion is to lay before you in detail the treatment that I have applied for the past six years to children ill with enteric fever, and to defend the cold bath treatment against the attacks of which it has been made the object.

After the employment of a number of different methods of treating this complaint, I finally decided, six years ago, upon a line of action in the management of children with typhoid, which I have invariably followed since the serious epidemic we passed through in January and February, 1894, and which has given me very satisfactory results.

I at one time treated a large number of cases of enteric fever with quinine, and I then observed that certain patients, nearly all children, react in a remarkable way to the action of this drug. I was in the habit of giving it in small doses, repeated in rapid succession, between four and six o'clock in the afternoon; sometimes the temperature was one degree Centigrade lower the following morning than the evening before, while the pulse would be less rapid, the patient's appearance better, and I would be informed that the night had been quiet.

This good result of the administration of quinine was not, however, obtained in every child. I found that with many—about two-thirds—there was no reaction at all; and for this reason I abandoned for a time the quinine method, and adopted the cold

bath treatment, which I applied systematically and exclusively for a period of two years.

I did not, however, forget the remarkable way in which quinine affects some cases of typhoid fever in children, and I was finally led to adopt definitely a compromise method of treatment, which I have used ever since, and of which I now propose to give you a general outline.

When I am called for the first time to a child with typhoid fever I always begin treatment with quinine to see whether the case may not be one of those that react to that remedy. Thus, when I have ascertained that the temperature taken in the rectum between four and five o'clock in the afternoon rises beyond 39° C. (102.2° F.), I prescribe, if the child is more than five years old, 0.75 centigramme (gr. 11½) of neutral bihydrochlorate of quinine, in three equal doses, to be taken at intervals of half an hour. When I next see the patient, the following morning, one of two situations presents itself: either the action of the quinine is perfectly manifest and shows itself by a lowering in the temperature of at least one degree centigrade ($1^4/_5$° F.), by a decrease in the restlessness during the night, and by improvement in the patient's aspect, or the action of the remedy has not proved to be favorable.

Then, in the former case, when the patient shows that he can be placed in the quinine category, I continue this method of treatment in the following manner: the temperature is taken in the rectum every afternoon between four and five o'clock; if at that hour it rises above 39° C. (102.2° F.), the 0.75 centigramme of quinine is administered at once, as described above, in three equal doses, at intervals of half an hour. If, on the other hand, the temperature is exactly at or below 39° C. (102.2° F.), no quinine is given.

In all cases in which quinine does not, *on the very first day,* lower the temperature and quiet the nervous symptoms, I have recourse at once, without waiting, to the treatment by cold baths, which is regulated in the following way: the first bath is given at 32° C. (90° F.) and lasts from eight to ten minutes. Three hours later the temperature is taken in the rectum; if it is over 39° C. (102.2° F.), a second bath is given at 30° C. (86° F.), and so on, progressively lowering the temperature of the bath until it reaches 25° C. (77° F.), unless some contraindication presents itself.

From that time on all baths are given at 25° C. It is unusual for me to order a bath at a lower temperature than that, the baths lasting from eight to twelve minutes. When the temperature, taken three hours after a bath, is found to be at 39° C. or lower, the bath is omitted, but the temperature is next taken two hours later. In a word, the temperature is taken in the rectum three hours after each bath, and when it is over 39° C. the bath is at once repeated; when it is at 39° C. or under the bath is omitted, but the temperature is taken in the rectum every two hours, and as soon as it is found to have risen above 39° C. the bath is repeated.

In a few cases the quinine treatment which had first been adopted and followed out for several days had to be given up and replaced by the use of cold baths; but such instances do not occur often. It is a remarkable fact that the children who from the start are relieved by the quinine treatment continue to be benefited by it during the entire course of the disease. The reaction is one that is peculiar to certain children.

My experience with this treatment extends over a period of six years, and warrants my assuring you that it gives the most satisfactory results and is without drawbacks.

From January 1, 1894, when I first adopted it, until December, 31, 1899,—that is to say, during a period of six years,—the total death-rate at the Clinic for Children's Diseases from typhoid fever has been seven per cent.; and I beg you to bear in mind that these statistics include *all* cases, even such as I should have a right to strike out, as, for instance, one case in which typhoid was associated with diphtheria, which ended fatally.

I do not wish to attach undue importance to this satisfactory showing, as I am quite convinced of the truth of the criticism made by Claude Bernard as to the value of statistics. If, however, my results be compared with the death-rate from the same cause at the Trousseau Hospital during the sixteen years between 1882 and 1898, which, according to Netter, was twelve and one-eighth per cent., they appear very satisfactory.

It is customary to bring forward three main objections to the use of the cold bath treatment of children with typhoid.

The first was made, I believe, by Fischl, who claimed that the cold bath cannot be relied on to the same extent to lower temperature in children as in grown persons. It would be easy to reply that the

salutary action of the water treatment is by no means confined to the lowering of the temperature of the body; but I shall content myself by saying that in most cases the bath at 25° C. (77° F.) used in the treatment of typhoid fever in children produces a fall of temperature which often reaches and sometimes exceeds one degree centigrade ($1^4/_5$° F.).

In the second place, it was objected that a child, plunged for the first time into a bath of cold water, might suddenly cease to breathe, owing to the shock produced by the low temperature. I have seen this happen only once; it was in the case of a child four years of age, to whom the first bath was administered at a temperature of 22° C. (75° F.). Even in this instance the cessation of breathing was of no importance, as the child resumed respiration as soon as it was taken out of the bath and struck briskly with a wet towel. I have never met with such a mishap since I adopted the plan of giving the first bath at 32° C., the second at 30° C., and the third at 28° C. or 25° C.

Finally, it has been said that children do not react promptly; that they get warm again quickly but manifest signs of collapse after the baths. It is necessary to come to some understanding as to what is meant by the term collapse. If it is meant that a child when placed in a cool or cold bath shivers after the lapse of a few minutes, and, when taken out of the bath, is slightly cyanotic about the lips and extremities, I reply that this is nothing startling; that these signs are always present in adults as well as in children. They are a part of the well-known and thoroughly understood group of symptoms caused by immersion in cold water. But with children, just as with adults, the reaction takes place rapidly when the subsequent measures are correctly applied, and when the baths are not given at a lower temperature than 25° C. (77° F.). If, in a given case, it is noticed that the reaction is not satisfactory, that the cyanosis continues, and that the pulse is bad, the treatment should be abandoned at once.

I am thoroughly convinced on all these points, because both in hospital and in private practice I have, whenever possible, been present at the first baths, and have personally directed the attendants in charge of the patients.

I have every reason to believe that if the treatment is not begun under the personal supervision of the physician himself, it will not

be intelligently followed out, its results will not be favorable, and the method, which often alarms the patient's family, and which gives a good deal of trouble to the nurses and servants, will be exposed to unjust criticism. It is probably for the same reason that at more or less regular intervals we are obliged to undertake the apology of a method of treatment which I am convinced has saved many an existence.

I have of late added to this line of treatment the use of hypodermic injections of artificial serum, with or without caffeine. The chief indication for these injections is, in my opinion, a very high temperature unaffected by the cold baths. When the temperature of a child with typhoid remained above 40° C. (104° F.) for several days, and was not lowered, or lowered only a few tenths of a degree, by the cold bath (though this is more unusual with children than with grown persons), I used to consider the situation as very serious, in fact, almost hopeless. In two such cases quite recently I used artificial serum together with the cold bath treatment, and had the satisfaction of seeing the patients recover.

FOR HOW LONG MUST A CASE OF PHLEBITIS BE IMMOBILIZED?

BY MÉRIGOT DE TREIGNY, M.D.,
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Pulmonary embolus is a danger to be apprehended in every case of phlebitis, except when the inflammatory process does not extend beyond the peripheral tissues of the vessel (periphlebitis); the chief aim of the physician, therefore, in the treatment of this disorder must be to prevent this catastrophe by immobilizing his patient for a sufficient period of time.

On the other hand, if immobilization is maintained too long (Pinard speaks of having seen patients kept on their backs for three and six months), it puts the patient to useless inconvenience and even suffering, and may possibly produce periarticular stiffening, ankylosis, extensive muscular atrophy, chronic œdema, and trophic disorders of the skin, that will subsequently require long and complicated treatment.

Now, most authorities, while laying stress on the risk incident to premature movement after phlebitis, are not sufficiently definite in fixing the length of absolute rest that is really necessary. Some merely recommend in a general way the confinement of the patient in bed for several weeks or even months; others are content to say that embolus must be feared even after a long lapse of time. It is, therefore, desirable to endeavor to settle this point of every-day practice.

In order to do this it is first necessary to understand clearly the structure and method of formation of the intravenous clot. The most recent research on this subject has shown that the initial phenomenon of phlebitis is a change in the wall of the vessel. The infective organisms attach themselves to the affected portion of the wall and set up a process of desquamative endophlebitis which becomes the nucleus of the formation of a coagulum. This is called the pre-obliterative stage of phlebitis. The primitive clot quickly

becomes firmly adherent to the wall of the vessel by connections that form between itself and the endothelial cells; the clot for this reason is not in itself a source of great danger, and although small septic emboli capable of disseminating infection are not uncommon, an embolus of sufficient size to cause mechanical obstruction may be looked on as of rare occurrence at this initial stage.

But at this diseased point of the vein the blood encounters abnormal conditions; contact with the infective clot, together with the hinderance or check it offers to the circulation, causes coagulation to extend in either direction within the limits in which the collateral circulation cannot compensate for the decreased calibre of the vein. Coagulation in some cases occurs very abruptly, and the resulting clot is much larger than the original one, and has very different characteristics according to the particular mode of its development. The primitive clot is white, tough, adherent to and fused with the wall of the vessel; the secondary clot is red, of less consistence, and simply lies in contact with a part of the wall which is smooth, without desquamation, and in which vessel inflammatory reaction occurs only at a late moment and with insufficient energy to cause adhesion of the clot; it is said that in some cases the secondary clot can be readily loosened several months after the date of its formation.

The proximal end of this clot, which is enlarged like a club or a serpent's head, is to be found where a collateral vessel opens into the main one; and, as it is constantly set in motion by the circulating blood, it is specially liable to become detached and form an embolus. The clot may also break loose in its entirety. In a case published by Dugnet the heart and pulmonary artery contained a single clot thirteen inches long. In another post-mortem, of which an account was published by the same author, the emboli found in the branches of the pulmonary artery formed on being placed together a clot nineteen inches in length.

Anatomo-pathological data show that neither the extent of the venous inflammation, its intensity, nor the degree of virulence of the pathogenic microbes has any very great influence on the frequency or gravity of the embolus. Its formation is purely mechanical, and is in all cases a possible consequence of a check to the circulation. It has been thought that the rarity of embolus

in cachectic phlebitis is due to the fact that the clot develops very slowly, and is thereby enabled to contract adhesions little by little during the process of formation. In any case we know that embolus is possible even when the inflammation of the vein is so unimportant as to escape detection, and in a former paper on this subject I cited some examples. This should always be borne in mind by the physician when called upon to treat cases in which phlebitis is possibly present. When he observes a disturbance in the temperature which cannot be explained by the existing disease, he should be in no hurry to get his patient up, and should carefully examine the veins. This precaution is still more imperative when, in addition to a rise in temperature, there are symptoms in the lower limbs, either more or less general pain predominating along the lines of the veins in the groin, behind the knee or in the calf, or else pain of a neuralgic nature radiating along the sciatic nerve, with a little œdema of the ankles.

The signs by which one can be guided in concluding that the intravenous clot is firmly enough adherent to allow a patient to get up are not easy to determine. Thus, the rapidity with which a limb returns to its normal condition, the disappearance of the blue or white appearance of the skin, and the more or less complete absorption of the œdematous exudate, may all deceive the practitioner, as in some few cases of phlebitis the external appearance of the region is in no way modified. Besides, the restoration of the local disorder depends chiefly on the degree of anatomical integrity of the collateral vessels and on the state of the general health. An embolus may form after the external signs have disappeared and the œdema has completely subsided.

On the other hand, a persistent varicose condition, with concomitant venous alterations, may unduly prolong the physical signs and lead one to infer the continuation of the inflammatory process.

Anatomo-pathological observation as regards the evolution of the clot has given varying results. As early as the tenth, or even the seventh, day clots have been found adhering very closely to the wall and difficult to detach. On the other hand, a French writer asserts from his researches that the clot may remain unadherent for several months. The most satisfactory investigations on this point seem to us to be those of Damaschino, who came to

the conclusion that at the end of ten or fifteen days from its first formation the clot becomes more difficult to detach and appears to fuse itself, at least at several parts of its circumference, with the vessel's wall without any perceptible point of separation; about a month and a half are required for it to become permanently adherent.

The interval after which patients have been allowed to get up without evil results would furnish a basis for an opinion were it not that the cases published neglect average results in favor of unusual instances. Schmitt, who in his thesis on rheumatic phlebitis estimates the period of rest at two months, cites cases in which patients got about without mishap at the end of twenty, twenty-six, twenty-eight, thirty-three, thirty-four, and forty days. In a case of phlegmasia after typhoid fever, mentioned by de Brun, the patient got up on the nineteenth day with no inconvenience other than slight pain in the calf of the leg. These instances must be regarded as particularly fortunate ones, and it would be injudicious to be guided by them in practice.

In about eighty case-reports that I have gone over, the longest period of detention necessitated by embolus was forty to fifty days after confinement, forty-five days after the beginning of typhoid fever, and seventy-two days after a fracture. But it is difficult to draw any general conclusions from these figures, as there is no mention of the exact date at which the phlebitis began, the cases having been studied from a point of view different from that which interests us now. Among the cases that are more explicit from our stand-point the latest accident reported occurred four weeks after the last venous coagulation. Some writers state that embolus is to be feared even after two months; and one, relying on a case published by Thirial and mentioned by Trousseau in his clinics, claims that sudden death is possible three months after the beginning of the illness.

This lack of unanimity appears to be largely due to the way in which different authors make their calculations. Some estimate the time between the first signs of phlebitis and the development of the embolus, not taking into consideration the ulterior manifestations of the disorder nor the clots that may form at different intervals after the first one. And yet it is self-evident that the later the formation of the clot the greater will be the danger from embolus.

Thirial's case, which is quoted by all writers with a meaning which Trousseau, for his part, did not ascribe to it, occurred in a man fifty-six years of age. Phlebitis began insidiously about December 20; it was only partially treated, and its existence was not positively confirmed until about January 10. On February 1 there was a second attack, which was recovered from after two weeks of relative immobilization. The patient then resumed his ordinary life for about a month. About March 15 another relapse occurred, which was followed by serious emboli on the 23d and 24th, and by sudden death on the 29th. It is impossible logically to carry the date of the origin of the coagulation that caused these emboli farther back than March 15; they therefore occurred eight, nine, and fourteen days after the phlebitis, and not three months, as is stated in all treatises.

In a word, in a case of phlebitis with a succession of acute phases each new coagulum that forms requires the same length of time to become adherent, and the period of immobilization can only be reckoned from the final acute phase. It is consequently necessary to watch the evolution of the disorder closely in order to detect even the slightest acute exacerbation of the inflammatory process. The course of the temperature may be looked on as a fairly good guide, as each acute phase manifests itself by a rise of temperature lasting at least several days. The continuation of pain, its reappearance after cessation at the original site, or its outbreak in a new region, are most important symptoms. When one leg only is affected and the patient complains of persistent pains in the lower part of the abdomen, you may be pretty sure that in a few days the disorder will appear on the other leg. When phlebitis has invaded the superficial veins of the thigh, the process may gradually extend with pain and swelling to the other side by way of the anastomosis at the middle line.

Even when there is little pain, sudden and persistent increase in the œdema indicates the formation of a new coagulum. So long as the disorder is progressive the patient's general condition will not be entirely satisfactory; sleep will be broken and the appetite will be poor. But noticeable improvement is at once perceptible when convalescence begins.

Anatomo-pathological data and the results of clinical observation indicate that there is little danger of fragmentation or breaking

loose of a clot after the lapse of six weeks from the date of its formation. From this we conclude that the average period of necessary immobilization can be fixed at six weeks and the maximum at two months, reckoning from the commencement of the last acute phase.

The formulæ adopted by Pinard, thirty days after the temperature has become entirely normal, and by Ribemont and Lepage, forty days after the same moment, correspond practically to the above estimate, and emphasize, moreover, the importance of the element fever as an indication of the activity of the process.

This limit of six or eight weeks is, however, not always sufficient. If at any time during the course of a case of phlebitis symptoms appear that point to the possible formation of a small embolus, such as sudden onset of difficult breathing, a stitch in the side, a chill, or a vague sensation of distress in the chest, mere prudence demands a further period of rest for six weeks at least from the date of their occurrence. These precautions may seem excessive, but they are warranted by the seriousness of the risk. It is known that emboli often follow each other at short intervals, and such an event may be the herald of disaster in the immediate future.

When the patient is finally allowed to get up the greatest precautions should be observed; if possible, the first attempt should be made under the physician's supervision. The affected region should be first surrounded with some supple elastic fabric that will exert moderate and even pressure. During the first few days all abrupt movements of the hip- and knee-joints must be avoided. Finally, it is well to be in no hurry to treat peri-articular stiffness, amyotrophy, and persistent œdema.

At a recent meeting of the Surgical Society of Paris M. Dagron advised movement as soon as the fever disappeared, the clot, in his opinion, being movable only during the period of pyrexia. This method, he claims, would have the advantage of preventing relapses, which, he thinks, are chiefly due to immobilization. The ideas on which this opinion is based are interesting, but not convincing. Thirial's case, mentioned above, shows at least that immobility does not always play the principal part in occasioning relapses.

Medicine

DIPHTHERITIC PARALYSIS; URÆMIA IN CONNECTION WITH DISEASE OF THE BLADDER; COAL-GAS POISONING; ARTHROPATHY IN LEAD-POISONING; SYPHILITIC LIVER; MYXŒDEMA.

REPORTS FROM CLINICAL LECTURES DELIVERED AT THE PENNSYLVANIA HOSPITAL.

BY J. M. DA COSTA, M.D., LL.D.,
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DIPHTHERITIC PARALYSIS.

Gentlemen,—The first case to which I shall call your attention is one of diphtheritic paralysis in a boy twelve years of age. He suffered from diphtheria for three weeks, the attack beginning in the middle of December. He has been very weak since his recovery from the diphtheria, this weakness being especially marked in the legs and back. His present condition first manifested itself by an impediment in speech associated with difficulty in swallowing. The boy was able to walk to the hospital on the day of his admission, but his gait was uncertain; it was found that he had diplopia for distant objects, and that a pencil held three and a half feet from his eyes was always seen double. The knee-jerks were absent, and co-ordination was defective, the boy being unable to place his finger-tips together; sensation was decidedly impaired, but electro-contractility of the muscles was good, and examination of the heart and lungs showed them to be sound. The urine also was normal. The boy has decidedly improved since admission, but he is still far from well. As you perceive, he answers questions with hesitation, showing that speech is still defective. The articulation is indistinct and there is a decided nasal

twang. The ability to swallow has somewhat increased. When he was admitted sensation was much impaired. Though the prick of pointed instruments could be felt, he was uncertain as to their number. Testing this now, we find that sensibility is still defective. On the right hand two points two centimetres apart are felt as one; at four and a half centimetres two sharp points are recognized as two, but in some places he thinks that there are three. The knee-jerks are still absent. Examination of the soles of the feet shows the plantar reflex to be absent on the right side and greatly lessened on the left, though sensation is present in both feet.

From the history of the case there can be no doubt as to the nature of the general condition with which we are dealing. Further, the difficulty in swallowing, the impairment of speech, the general debility, the lost sensibility, the absence of knee-jerks and other reflexes, all point to the presence of diphtheritic paralysis.

The first symptom in these cases is apt to be difficulty in swallowing. This comes on soon after the attack of diphtheria, and fluids taken are regurgitated. In some cases the paralysis does not go beyond this stage and remains localized. But in other cases, as in this instance, the involvement of other parts is a precursor of a general extension of the condition. There were no shooting pains in this case, and, in fact, pain is very rarely present in diphtheritic paralysis.

Where is the lesion? Two almost opposite views are held regarding this question, and both have many supporters. The first is that the affection is a multiple neuritis. According to this view, the diphtheritic poison acts as lead so frequently does upon the superficial nerves, the neuritis thus caused leading to the paralysis. The second view is that the poison exerts its toxic influence upon the central nervous system, affecting especially the parts in the neighborhood of the medulla. It is difficult to decide which of these theories is the correct one. When, however, we take into account the absence of the knee-jerks and other reflexes, the fact that there is first a local paralysis of the nerves of deglutition, that the paralysis afterwards becomes general and is symmetrical, that sensation is greatly impaired, and that the patients generally recover, I think the weight of evidence is in favor of a peripheral rather than of a central paralysis. But be this as it may, there is

no doubt that this paralysis develops late in diphtheria, and that it almost always yields to treatment. The blood has not yet been examined in this case, as it will be, and as it should be, in every instance; there is always anæmia, and the cases in which this is marked are slowest to recover.

I have said that most of these cases of diphtheritic paralysis get well. On looking back over a large experience I do not, indeed, recall a single instance that did not end in recovery. This is first manifested by a return of the reflexes and of sensibility. The treatment that succeeds best is one directed to the improvement of the general nutrition by careful nourishment, by the use of cod-liver oil, of iron, of the hypophosphites, and of strychnine. Electricity, too, is of use, both as a stimulant and as an alterative of the cutaneous and general nervous systems. The continuous current of about sixteen cells will be employed in this case, particularly on the arms, in which the lack of power is very marked. So the treatment will consist for the present of the electric current, a dessertspoonful of cod-liver oil three times a day, with twenty drops of the syrup of the ferric iodide, and courses of strychnine will be also from time to time employed.

The boy walked into the clinic-room in a few weeks entirely well.

URÆMIA.

This patient is forty-nine years old. His mother died of asthma, and he states that he has had diphtheria. His mind has been very dull since he entered the hospital, and to his statements much weight cannot be given. He tries to answer questions, but cannot fix his thoughts upon a subject. This much we learn, however, that he had frequent and scanty micturition before his admission; also that at times he has spells of weakness during which he does not know what he is doing.

Upon admission the patient's breath was offensive and had a urinous odor. His tongue was heavily coated, articulation was indistinct, and his eyes moved sluggishly with a vacant stare. The pulse was slow, but no cardiac murmurs were heard. The urine showed a heavy deposit, some albumen, pus, and triple phosphates, was alkaline, and had a specific gravity of 1014. During the first twenty-four hours it dribbled and could not be collected. In the

second twenty-four hours fifteen ounces were voided, and in the third, twenty-four ounces. Since that time it has been about half the normal amount. On account of the man's mental dulness and curious spells of vacancy the urine was tested for urea, and it was found that less than nine grammes were being passed in twenty-four hours. The patient's skin was dry and hot, though the temperature was little above normal.

The pupils are now normal, the pulse is 80 per minute, and the patient knows where he is, which for some time he did not. He is very weak and has a severe headache. There is no doubt as to what the man is suffering from, the marked diminution in the amount of urea secreted sufficiently explains his stupor. The only question is as to what has given rise to this action of the kidney. Did he have a previous disease of the kidney? The urine was alkaline and contained phosphates and pus, but no tube casts were found. I think this is a case of uræmia in which the action of the kidney has become disturbed in consequence of purulent urine. Where does the pus come from? It is exceedingly difficult to tell whether it is from the bladder or the pelvis of the kidney without some knowledge of the previous history of the case. But, broadly speaking, frequent micturition, alkaline urine loaded with phosphates, with a small amount of albumen, would be in favor of the view that the bladder was the original source of the trouble now present.

What are the symptoms of uræmia? Dulness of mind is always marked; frequently, also, difficulty of deglutition. At first there are dilated pupils, but this sign afterwards disappears. Then there is a common symptom which is very significant; it is that the patient is not cognizant of where he is, not even knowing his own home and asking to be taken there. This symptom is often present when there is no confusion about anything else. Convulsions may or may not occur; they are absent in the majority of cases. The usual impression with reference to uræmic attacks is that they are in the nature of an explosion and are violent. This is not a correct view, for they more often resemble a mild form of delirium, such as is seen in the case before you.

What causes uræmia? Retention of urea it may be said; and, broadly speaking, this is correct. But modern research has shown that it is not retention of urea alone which gives rise to the toxæmia,

but that the urea undergoes a change and secondary poisons are generated, or that an albuminous product is formed different from anything in normal urine. In proof of this, urea has been injected into animals like man in their constitution and habits, and neither stupor nor convulsions have been produced. There is, then, some poison other than urea that causes the convulsions, which must come from its decomposition or be otherwise formed. There is much work still to be done by investigators to determine the true nature of uræmia, and why the action of the poison on the nervous system produces stupor in some cases and convulsions in others.

The patients, when they recover at all, generally do so gradually. One case I saw recently in consultation was of great interest. There was absence of convulsions, but dulness was present; the idea of not being in his own home was marked. The urea excreted was somewhat less than half the normal quantity. After a time the quantity of urea secreted became normal, but the patient did not get well. The curious delirium and stupor still remained, and the nervous system did not seem to recover. Then the urine suddenly increased to seventy ounces daily, and at the same time twelve hundred grains of urea were passed. From that time recovery was rapid. In these cases the urea gets, as it were, locked up in the system, and the patient does not recover when the normal amount is passed. Then there is a critical discharge, if I may use the expression, and recovery takes place. So this extra amount may remain when a normal amount is being secreted.

As to prognosis, this depends very much on the extent of the kidney lesion. Here, where the kidney affection is a secondary one, due to extension from the bladder, I think recovery will take place. (The patient recovered entirely.)

The treatment used in this case was vapor baths at 115° F. for half an hour at a time. These may be employed from two to four times a day according to indications. Pilocarpine, one-eighth grain, was given every four hours, at first hypodermically and afterwards, when the patient could swallow, by the mouth.

The patient has been purged every morning by half an ounce of magnesium sulphate. The infusion of digitalis has also been given in the dose of half an ounce every four hours. Everything has been done with the view to keep up the activity of the skin, bowels, and kidneys, and the results obtained have been satisfactory.

Active purgation is a most essential part of the treatment, and for this salines are the best. The diet should be of the mildest sort. Milk alone is the best if the patient can live upon it. If he cannot, then chicken or clam or oyster broth may be partly substituted, but milk is much to be preferred.

Can anything else be done? Yes; especially if the bladder is implicated, we must see to it that the urine is kept disinfected. If there be pyuria, boric acid or sodium benzoate may be used, or urotropin, which is very serviceable, forty grains daily, in ten- or fifteen-grain doses; it is generally well borne by the stomach.

COAL-GAS POISONING.

This case is that of a man who attempted suicide at an early hour in the morning. He was found in a barber shop in a building which he had entered the night before while intoxicated. There was a wound in the throat, but it was only a superficial cut, no structures of importance having been divided. The man was unconscious when discovered. At the time of admission to the hospital his respiration was superficial and labored, he was markedly cyanotic, and was frothing at the mouth, his pulse was weak, the pupils were dilated; he was profoundly unconscious. Three hours after he was found his temperature was 100° F. It afterwards rose to 102°, then fell suddenly to normal, and has since remained so.

This, then, is a case of poisoning by coal-gas. I do not believe that the gas was inhaled with suicidal intent, although there is no doubt about the man's cutting his throat. As to the gas, he probably turned it on, and in his partially dazed condition forgot to light it. This, however, is immaterial so far as the case concerns us. The man remained very stupid for a time. Inhalations of oxygen were given, and strychnine was administered hypodermically. After a time he rallied and went on slowly to recovery. He is now practically well. As he began to recover he complained of frontal headache, which continues to some degree. Though there is no fever, the skin is somewhat flushed, but it is not so red as at the time of the patient's admission. The heart is normal, though the sounds are not strong. The man is deaf, but this condition is due to an attack of typhoid fever some years ago. Deafness is a rather unusual sequel of typhoid fever, for, while it is not

infrequently noted during the attack, the hearing is seldom permanently affected after recovery. The administration of strychnine is being continued every fourth hour, but the oxygen has been discontinued. There was a slight trace of albumen in the urine when the patient was admitted, but any stress on the respiration, such as was here present, is liable to cause temporary albuminuria.

This form of poisoning is not often met in this country, but in France, where charcoal is extensively used, it is of frequent occurrence. I have seen the condition several times. One instance was that of two country-bred people who came to the city and blew out the gas. I have also seen it as the result of a leaking gas-pipe. The same condition is produced whether the agent be ordinary illuminating-gas or charcoal. Water-gas is extremely dangerous, and it is a question whether its use, except in very limited admixture, should be permitted in dwellings. More than ten per cent. of water-gas in illuminating-gas is an element of danger.

Why does carbonic oxide gas poison when it is inhaled? Because of the strong affinity it has for hæmoglobin. The gas enters into combination with this substance, which will then no longer carry oxygen. The gas acts as a poison by thus preventing the hæmoglobin performing its physiological function. The state of the blood accounts for the red color of the face and for the redness of the nails which are often present. The blood also appears unusually red if it be drawn at this time. This redness of the skin remains if death occurs without resuscitation, and because of it it is sometimes difficult for the laity to realize that death has really taken place. Besides this peculiarity in the color of the skin and nails and the red appearance of the blood, there is another characteristic of this form of poisoning,—the profound unconsciousness of the patient. All individuals poisoned in this way become comatose, and can be aroused from the coma only by intervention. This patient would have died if he had not been discovered opportunely. Regarding the respiratory distress, there is not often any change in the breathing itself except as a consequence of the general condition.

With reference to treatment, the most important thing is to get pure air into the lungs. Open windows, throw water on the patient to excite deep inspiration, give inhalations of oxygen if a cylinder can be quickly obtained. It is also well to stimulate. In

this case strychnine was given hypodermically. The slight heart weakness that still remains is being met by continuing the strychnine, which can now be given by the mouth.

ARTHROPATHY IN LEAD-POISONING.

The next case I wish to show you is one of lead-poisoning. It is interesting not so much on account of the poisoning as of one of its consequences. The man has been a worker in lead for twenty years, but this is the first grave attack of poisoning he has had. When he came to the hospital he was profoundly poisoned. He had severe colic, wrist-drop, and also, what is unusual in these cases, foot-drop. But it is not these symptoms to which I wish to call your attention, but to the fact that he had pain with arthritic change in all his joints. There was no doubt as to the nature of the case, for there was marked constipation, and a well-defined blue line was visible on the gums. The patient was placed on potassium iodide in decided doses, and the result has been very favorable. His general condition has greatly improved, and the blue line on the gums has nearly disappeared. The joints, with the exception of one, the right ankle-joint, are no longer painful. The other joints were not swollen at any time during the course of involvement, but this one has remained extremely painful and is also swollen. It presents a well-marked type of the joint affection that results from lead-poisoning. There is still tenderness on pressure over the joint, at places other than where a blister was applied for attending neuritis of the leg. There is some motion in the joint, but not a normal amount, the lateral motion in particular being very limited. The capsule of the joint is undoubtedly thickened, but there is no evidence of marked effusion. This, then, is a case of lead-joint, a condition in which there is an inflammation of the capsule, almost invariably some swelling with but little effusion, and severe pain. Joints affected in this way are generally more painful, but not so red, as in rheumatism. This is a distinguishing feature between the two diseases, the lead-joints being, as in this case, pale rather than red. Another curious point about lead-joints is that the swelling has no tendency to move from joint to joint, as in rheumatism. Here all the joints were slightly affected for a time, but all are better except this one, which remains painful. There is, however, no tendency for the process to spread

from it to other joints. In lead arthropathy there is no involvement of the heart. Neither albumen nor sugar has been found in the urine, though a small amount of albumen is not infrequently present in these cases.

The prognosis is favorable. The treatment has been the same as that indicated in general lead-poisoning,—namely, the exhibition of potassium iodide. This has been given in ten-grain doses three times a day. The next question is whether we can in any way hasten resolution by local treatment. We shall, for this purpose, envelop the joint in a plaster consisting of equal parts of mercurial plaster and lead iodide plaster.

SYPHILITIC LIVER.

This man, twenty-eight years old, was admitted December 1. His previous history shows that he has had measles, scarlet fever, whooping-cough, and later several slight attacks of pneumonia. He is not intemperate, but he presents unmistakable evidence of specific disease dating back eight years; that infection poisoning was very severe is shown by the numerous cicatrices on various portions of the body. Four weeks ago the patient fell down-stairs and sprained one of his ankles, in consequence of which he was obliged to remain in bed for some time. During his confinement he noticed that he was growing unusually weak, and that both ankles had become swollen. Another disease was developing, and for this he sought admission to the hospital. We find that the urine has a specific gravity of 1014, and contains a small amount of albumen; but no casts, sugar, or bile. The temperature is normal. The spleen is slightly enlarged, extending a trifle beyond the margin of the ribs. There is no cough nor any disease of the lungs or heart. The tongue is clean, and there are no marked gastro-intestinal symptoms. On inspecting the abdomen a remarkable state of the blood-vessels is noticed, the veins being everywhere distended, this condition extending to the lower part of the chest also. The liver dulness is increased; it begins at the lower border of the fourth rib and extends two fingers' breadth below the ribs and across the epigastrium. There is no ascites. What, then, is the cause of illness in this case, the only symptoms present being increase in the size of the liver and distention of the veins?

It is very evident that there is interference with the flow of the blood in the portal circle. The enlarged liver is smooth; there is no tenderness and no ascites. There are two or three diseases to be considered as possibly present, one of them being hepatic cancer. In this affection there is great enlargement of the liver; it, in fact, occasions the greatest degree of enlargement that occurs in hepatic diseases; but against its being here present are the facts, first, that there is no tenderness and that the liver enlargement is smooth; secondly, that cancer is, as a rule, attended by ascites; thirdly, that there is no history of cancer in the family; fourthly, the age of the patient. We must conclude, then, that the disease is not cancer of the liver.

There are two non-malignant conditions which might be present. In hypertrophic cirrhosis there is a fibroid condition of the liver that is attended by the development of irregularly shaped masses. This condition might give rise to the enlarged liver and the distended veins. But, in point of fact, distention of the abdominal veins is not among the signs of this disease, while tenderness and jaundice, both here absent, are. Dropsy is not an ordinary symptom, although it is present in a certain proportion of cases. The other condition to be thought of is specific disease of the liver, a syphilitic hepatitis with gummata, which I believe to be the case in this instance. The cicatrices all over the body showing the results of the specific infection, the liver swelling without jaundice and tenderness, the enlargement of the superficial veins of the abdomen, and the absence of dropsy are also in favor of this view. The only point in which the condition differs from ordinary syphilitic liver is that there are no irregularities to be felt on the surface of the liver; but a diffuse syphilitic hepatitis with small nodules might well exist without these being perceptible through the abdominal wall.

As to the prognosis, it is more favorable than in either of the other two diseases mentioned. To bring about recovery the man will be put upon antisyphilitic treatment at the start, one-thirtieth grain of mercuric chloride and ten grains of potassium iodide three times a day; these doses will be gradually increased. Plain, bland diet will be given, and also an occasional morning laxative of two drachms of sodium phosphate.

MYXŒDEMA.

The patient whom I now bring before you is one whose case is of great clinical interest. He is a man of forty-seven, and was admitted to the hospital December 14. His family history is good; his father had heart disease, but there is no tuberculosis in the family. I intend to work out the case before you and let you make the diagnosis; but whatever the disease is from which he is suffering, his sister had the same affection. The patient had the usual diseases of childhood and four or five years ago an attack of St. Vitus's dance. At this time he had rheumatism, but the history is not one of an acute attack, he having suffered more or less from the disease all through his life. He does not use alcohol nor is he a smoker. There is no history of specific infection.

The man's present condition began fifteen years ago, when he noticed that he was beginning to increase in size. He weighed one hundred and fifty pounds at that time, and although he has not been weighed since coming to the hospital, it is evident that he weighs much more now. We shall have him weighed to determine how much the disease has added to his weight.

The affection began with a swelling of the face; after a time the hands also became swollen, and later the legs were involved, the disease thus spreading over the entire body. It was also noticed that coincident with these changes the man's memory began to fail. Then his gait became affected and he walked with difficulty, his movements being slow and weak. In a few years his speech became slow and hesitating, as is noticed at the present time, the tongue being thick and cerebration sluggish. In the last few years his disposition has changed too, and he has become very irritable. Eight years ago the patient's hair began to drop out, and it is now hard and brittle.

We have here a series of conditions causing great changes in this patient, and also apparently a high degree of dropsy. This is the man's history. Let us now examine him for ourselves and see what his condition really is. The face is distinctly swollen, as is easily seen, the swelling being especially marked towards the neck, where it forms a double chin. The cheeks are swollen and the eyelids also, the latter presenting a somewhat baggy appearance. In the forehead furrows are still to be seen despite the swelling, but they are not at all marked. The ears are large and swollen, espe-

cially the lower parts. There is a slight flush on the cheeks, which the resident tells me is not due to excitement from being in the clinic, for it was observed in the ward. The skin does not pit on pressure, and the capillary circulation is easily augmented by friction, as is shown by the prompt reddening of the skin. The nose looks to be broader than normal at the base, but the patient does not know if this is the case; the mouth too, if not really larger, appears so by reason of the thick lips. The skin of the hands and forearms, though swollen, can be pinched up in folds and does not pit on pressure. One thing, however, that is very striking is the extraordinary dryness of the skin on all parts of the body. The legs are also somewhat swollen, though but very slightly about the ankles. In short, the legs show to a minor degree the same changes as were noted in the arms and face. The patient's temperature is subnormal in type, being 97.2° to 98° F. The pulse is slower than normal and is weak. As regards the heart, the first sound is feeble; the second is moderately distinct but not accentuated. There are no murmurs, no increase in size, and the impulse is feeble. Examination of the abdomen reveals a slight enlargement of the left lobe of the liver, which can be distinctly outlined by palpation. The right lobe cannot be felt beyond the margin of the ribs. The splenic dulness seems to be somewhat smaller in area than normal. Percussion reveals the fact that no ascites is present. The man has normal digestive powers, the appetite is good, the tongue clean, and the bowels regular. The urine is clear, acid in reaction, has a specific gravity of 1016, and contains neither albumen, sugar, casts, nor bile. Lastly, the condition of the nervous system must be inquired into. The knee-jerks are diminished. Sensation is perfect and the tactile sense is well retained. Electrical reaction of the muscles, even over the swollen arms, is normal. Having thus worked out the case in all its details, we reach the diagnosis, which is, that we are dealing with a case of myxœdema. What does the diagnosis rest on in this case? We must first speak of the apparent dropsy seen in the patient. We say *apparent,* as the gradual swelling noted in the history of the case would at once suggest kidney disease as its explanation, but that there is no dropsy is shown by the fact that pressure is not followed by pitting. The condition of the urine also shows that there is no disease of the kidney present. But suppose a small amount of

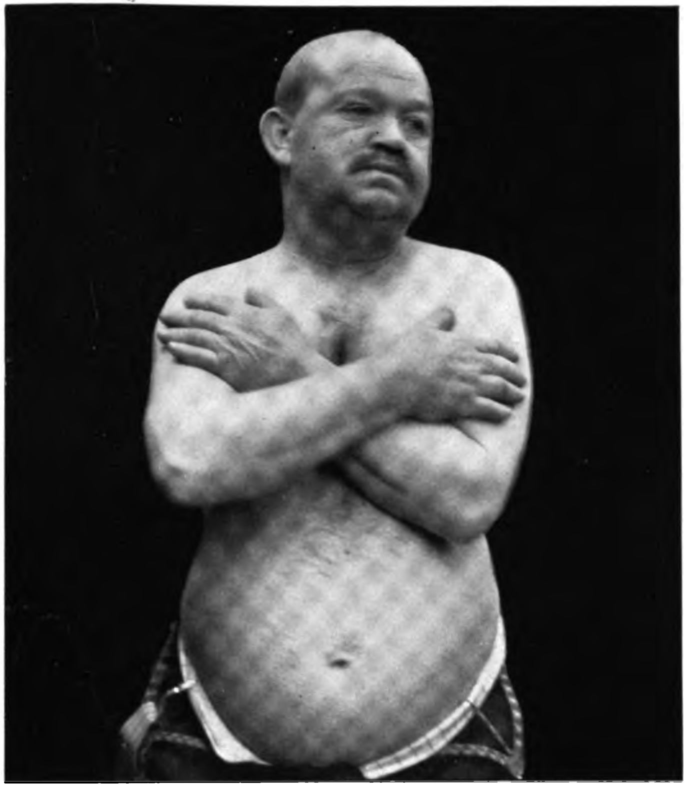

Fig. 1.—Dr. Da Costa's case of myxœdema before treatment with thyroid extract.

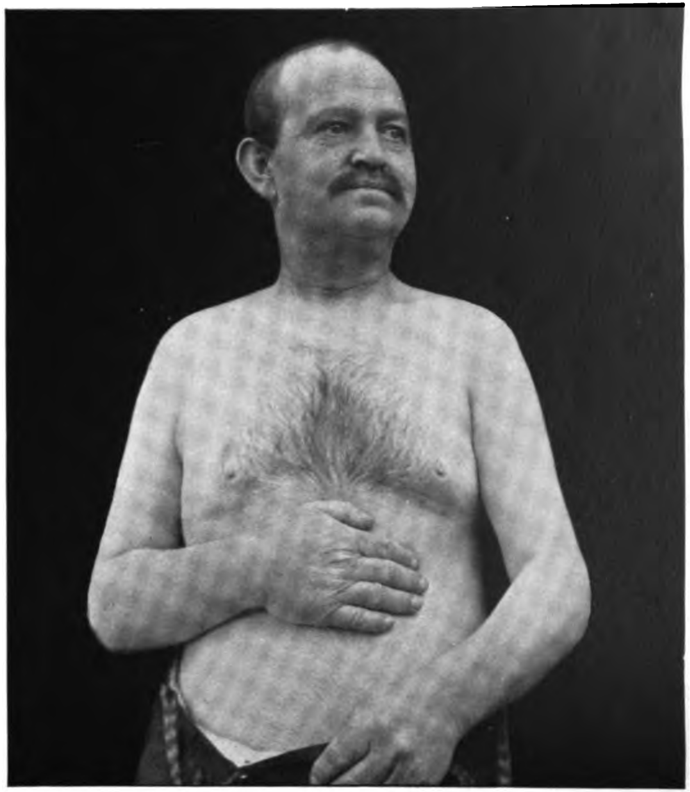

Fig. 2.—Dr. Da Costa's case of myxœdema after treatment with thyroid extract.

albumen had been found in the urine, would this have changed our opinion regarding the nature of the disease present, and led us to say that we were dealing with a case of kidney disease? It would not, for the reason that in the clinical history of myxœdema we find that later in its course small amounts of albumen do appear in the urine. Therefore this would not have influenced the diagnosis. Again, what, irrespective of the swelling present, is in favor of myxœdema? First, there are the extraordinary mental changes, especially the slow, hesitating speech not unlike that sometimes found in cerebro-spinal diseases. There is no skipping or cutting short of syllables, but rather a scanning of the words. There has been no vertigo nor other cerebral symptoms of that sort. The patient is, besides, mentally defective, and his temper is irritable. At times patients with this disease grow suspicious of those around them, and some even eventually become insane. Further, the great dryness of the skin is significant, and the falling out and brittleness of the hair are also characteristic. In short, the symptoms are in every way typical of myxœdema, and no internal disease can be found. The question then arises as to what myxœdema really is. It is one of those diseases with which we have become familiar only in comparatively recent years. The similarity of the symptoms to those of cretinism was first noted, and this was followed after a time by the brilliant clinical discovery that in myxœdema the thyroid gland was absent or atrophied. Examination of this patient reveals no evidence of the presence of the thyroid gland; that organ is apparently entirely lacking. But I wish to call attention to the difficulty which is met with in finding the thyroid in the great majority of healthy adults. I had observed this fact in the examination of patients with other diseases, and to determine the matter I made observations on a large number of healthy people, and found that I could not discover the gland by palpation. So in this case we left this point until the last, in order that the diagnosis of the case might not be made on this point, seeing that the absence of the thyroid to touch is so common in adults. Clinically, then, in myxœdema the absence of the thyroid gland is not of much significance, but pathologically it is of the greatest importance, its absence or atrophy being the essential pathological condition of the disease.

What now is the prognosis and what is the treatment of this disease? The prognosis is far more favorable than formerly, as before

the disease was understood it was invariably fatal. This affection illustrates one of the greatest advances in scientific medicine. This consisted in ascertaining the cause of the disease and in the discovery of the efficacy of the thyroid gland when used therapeutically. As a result of this discovery, when a case comes to us early enough in its course we may confidently look forward to a cure. The treatment consists in the administration of the extract of the thyroid gland or of the gland itself. The first attempts in this line consisted in the introduction into the abdomen or other part of the body of the gland itself taken from a sheep or other animal. This was, of course, a very crude method of treatment. Then a glycerin extract was injected under the skin of the patient. Now the gland or its extract is given internally. The extract is just as efficacious as the gland itself, for it has been found that desiccation does not impair the therapeutic properties of the gland. Thyroid gland capsules are now the most generally employed means of administration. As to the dose, the statements of writers differ. The amounts recommended vary from one grain to as much as ten or even fifteen grains. My own opinion is that five grains three times a day are sufficient. It is better to take a little longer time to secure the effects of the gland than to give it in large doses at the outset. It must be remembered that this is not a harmless remedy, but that it is an active preparation like opium or strychnine, and must be used with the same precautions. If the doses are too large, delirium and marked fever may be produced, the temperature rising almost instantly. This will also be accompanied by nervous agitation of varying degrees of intensity. To be on the safe side, then, begin with one- or two-grain doses, and gradually increase to five if the patient can stand this amount. My experience is that this is the best dose, and should not be exceeded. The disease is a chronic one, and necessarily requires protracted treatment.

The question arises as to what principle in the extract the property of influencing the disease is due. This is believed to be a body known as thyro-iodine. This is a special principle in the gland itself, as iodine alone cannot accomplish the same results. When this principle is supplied artificially by giving the extract, we replace that which is lost to the body by the absence of the thyroid gland itself, and thus supply an element which the constitution needs for its maintenance.

LOBAR PNEUMONIA; DERMATITIS ARTIFICIALIS; SEQUELÆ OF MILD ACUTE ARTICULAR RHEUMATISM; TUBERCULOSIS CUTIS; GENERAL TUBERCULOSIS; CHRONIC NEPHRITIS; CHRONIC ARTICULAR RHEUMATISM, ITS SEQUELÆ; PLEURITIS SICCA; DIABETIC GANGRENE.

CLINICAL LECTURE DELIVERED IN THE WARDS OF THE COLORED HOSPITAL, NEW YORK CITY.

BY LOUIS FAUGÈRES BISHOP, A.M., M.D.,

Assistant Attending Physician to the French Hospital; Attending Physician to the Colored Hospital; Late Chairman of the Section on Practice of Medicine, New York Academy of Medicine.

LOBAR PNEUMONIA.

Case I.—This woman, K. K., is thirty-six years of age. Her past history is uneventful. Ten days ago she had severe pain in the right ear. The attack appeared somewhat like la grippe, but eight days ago she began to suffer from pain in the right side; she had headache and backache, was short of breath, and had some fever. She was chilly, but did not have any distinct chill. The following day I saw her, and then I found that her respirations were increased, the pulse was rapid, and the temperature 103° F. The physical examination showed pronounced dulness over the right lower lobe, bronchial voice and breathing. The sputum was blood-stained at the beginning, but afterwards not so much so, but it has been streaked from time to time since. She progressed fairly well, having an even temperature, until I saw her day before yesterday, when I noticed that she was not doing so well. Her sputum, which had been frothy, had become again streaked with blood. Upon examination I found that the left base had become inflamed, showing dulnesss and bronchial voice and breathing. Of course, that accounted for her condition not being so good. Since day before yesterday I have not seen her. To-day I find her short of breath and suffering from a good deal

of pain in the left side, the original location of the pain being in the right side. For two days the sputum has been streaked with blood; to-day it is not so much in quantity, probably from the patient's inability to cough it up. Examination of the right lower lobe shows a distinct bronchial voice and breathing, giving way in places to more natural breathing, and the presence of a great many moist râles. This shows that resolution has commenced on the right side. To-day I find on the left side a pleuritic friction-murmur and râles which obscure the intrapulmonary condition. But, having beheld her two days ago, and noted the signs of consolidation, I feel confident that underlying the pleurisy is the consolidation of a pneumonia. Therefore, we have here a patient who began ten days ago with an acute lobar pneumonia involving the right lower lobe of the lung, not of very severe type, because the temperature, pulse, and respiration were only moderately altered. She did not appear to be very sick, so that even some of the nurses thought that the case was not of importance compared to some of the others in the ward; they did not think a patient with pneumonia could look like that. The disease ran a fair course until about the time when defervescence might be expected, namely, the eighth day of the disease. Then, instead of defervescence taking place as was expected, a pneumonic process started in the left lower lobe, and she now presents a repetition of the same symptoms she presented in the beginning. She has the same severe pain, expectoration, and temperature; and she will have to go through the pneumonic process in the left lower lobe as she did when it involved the right lower lobe. The upper lobes are clear, and she has a sufficient amount of lung uninvolved to fulfil the office of respiration, so far as the functions are concerned, but the outlook is very grave on account of the strain on the heart.

Pain is the most prominent symptom, and the relief of it is, of course, important. The most rational thing to do is to immobilize that side of the chest and apply warm, soothing poultices. If necessary, a small amount of morphine may be allowed, to help deaden the pain. This pain will soon subside, and she then will be much more comfortable. Of course, she is very sick; but I see no reason why it is impossible for her to continue to improve and make a good recovery. The treatment has been practically expectant, although she has received a mixture as follows:

℞ Tincturæ aconiti, ♏ss;
Tincturæ digitalis, ♏iij;
Spiriti frumenti, ℥iij.—M.
Sig.—To be taken every three hours.

Besides this she had been stimulated with whiskey. This amount of aconite and digitalis has not produced any appreciable effect. I think poultices and moderate stimulation will yield just as good results. The employment of aconite in pneumonia has been a subject much discussed, especially as to when and how it should be used. I believe that when patients can be watched all the time, and the pulse, temperature, and other conditions followed closely, it is a drug capable of alleviating the symptoms of pneumonia in a marked degree, by reducing the temperature and pulse and lowering the sthenic qualities of the disease. In private practice I do not use it very often. I saw some instructive experiments with aconite when house-physician in St. Luke's Hospital at a time when pneumonia was very common in New York. Five cases were placed in five adjoining beds; these cases had advanced to about the same day of the disease. They were all treated with aconite, or aconitine, digitaline, and strychnine. At that time that combination was quite popular and much talked about. These patients all recovered. The pulse was in all markedly influenced by the treatment, and alcoholic stimulants were not given until the crisis. They ran a mild course and all defervesced by crisis. The critical time was when the temperature fell; that is a period of danger in these aconite pneumonias. When the temperature came down the pulse became feeble and irregular, and it was very alarming indeed. I remember several of these cases in which the pulse seemed to be wavering, and strophanthus, whiskey, ammonia, coffee, and every available stimulant was used to tide the patient through defervescence. When the period of defervescence was passed their recoveries were uneventful. But I soon became suspicious of one of the drugs of the combination. The aconitine was to reduce the temperature, and the digitaline and strychnine were to stimulate; it appeared to be a fine combination. But I became doubtful of the digitaline on account of its known unreliability, and I soon made up my mind that digitaline had practically no effect. I took five persons who were not sick, and gave them one hundred doses in one hundred consecutive hours; I then made a sphygmo-

graphic tracing and no change was noted. So I think I am justified in speaking of cases treated by aconite as "aconite cases." Although they did well and all recovered, I confess I do not feel safe in using sufficient aconite to get its physiologic effect in pneumonia. It may improve the patient's apparent condition, but I feel that it increases the danger of defervescence.

This patient has not shown any aconite symptoms, and she cannot be referred to as a case treated by aconite. She has been treated expectantly. Pneumonia is a short disease, and if we overfill the stomach with milk there will occur a great deal of flatulence, which interferes with respiration. She has had broths and fluid foods. She had some pain and swelling of the left foot from a phlebitis, which has now improved. The pleuritis has heretofore been relieved by poultices. There is no way to prevent pneumonia from passing from one lobe to another. In judging the patient's condition in pneumonia, not only should you feel the pulse, but you should always examine carefully the heart-sounds, particularly the pulmonic second sound, because the pulmonary circulation and the systemic circulation are two different things, and the right side of the heart can fail to do its work well without the left side showing it.

DERMATITIS ARTIFICIALIS.

Case II.—This is a rather curious and interesting case. A very good authority made the diagnosis of dermatitis artificialis, the lesions resulting from scratching. The girl's condition is not very good, and the lesions cause cicatrices and pigmented areas which are quite suggestive of specific disease. The diagnosis was confirmed by the fact that the iodides and mercury had no effect. In spite of specific treatment the trouble has progressed, and the lesion heals but slowly.

SEQUELÆ OF MILD ACUTE ARTICULAR RHEUMATISM.

Case III.—This young girl, M. L., presents conditions of extreme interest to us. She came into the hospital on September 14, having previously suffered from an attack of rheumatism of mild degree, so mild that her illness was not considered to be of particular importance. I regard rheumatism as a serious disease in children. I always order them to be placed in bed and kept under treatment,

because even the very mild cases may result in the condition you see represented here. This child had a mild attack of rheumatism, was up and about, when an endocarditis developed insidiously and the valves became badly deformed. A large number of cases do not go on as rapidly as this one; but, as the valves become incompetent, the heart does more work, acquiring a compensatory hypertrophy, so that the heart actually does its work, although in a laboring manner. That is what we hope will happen to this girl, for, unfortunately, before her heart had had time to hypertrophy and get strong enough to do its work with damaged valves, she was allowed to go about, and the congestion caused changes in the kidneys,—a complicating nephritis. Then, of course, she began to have œdema and fluid accumulations in the different cavities of the body. As you can see, there is great distention of the abdomen, although it is less than last week. She has some œdema of the feet, less noticeable now that she is lying in bed. Œdema of the face is also present. The pleural cavities contain a moderate amount of fluid. Since her entrance into the hospital she has improved. Examination of the heart disclosed a systolic loud murmur when she entered, and the heart's action was quite feeble, showing that the heart had not compensated for its incompetent valves. The case is, to me, very interesting as showing this course of rheumatism in children. When these heart cases suddenly develop a marked degree of œdema it generally means involvement of the kidneys. The urine was loaded with albumen and moderate in amount. Now the albumen has diminished.

The treatment consisted of absolute rest in bed, milk diet, and the use of digitalis to increase the force of the heart. We must wait for the heart to recover its tone; then the congestion of the kidneys will clear up and the œdema and ascites gradually disappear. As a matter of course, if the girl should suffer greatly from dyspnœa, we would remove the fluid from the abdominal cavity and the chest; but so long as there is no interference with the functions it is better to wait until the fluid is absorbed. Here we advocate the use of the aspirator, but not too frequently. Wherever we detect the slightest signs of failure of the pulse or respiration we should always remove the accumulation of fluid. I think we can look for a good recovery in this case, although the child will have a large heart; and in two or three months from now you may

possibly notice pulsation and heaving of the chest, but she will be free from dropsy and fairly comfortable.

The later history of these cases is not altogether satisfactory. The hypertrophied tissues have a tendency to degeneration. After a while these children develop large hearts, with more or less degeneration, and they do not generally survive past middle life. It is an interesting fact in rheumatism in children that not only are the valves involved, but also the fibrous structures, and with them the muscular tissues of the heart. Dr. William H. Thomson believes that myocarditis is not uncommon in children.

TUBERCULOSIS CUTIS; GENERAL TUBERCULOSIS.

Case IV.—The next patient, E. J., is thirteen years of age, and presents an interesting case of tuberculosis, in which the disease seems to have involved some unusual structures. In the vast majority of tuberculous cases the involvement is of the lungs. Once in a while these organs appear to be immune, and tuberculosis becomes extensively developed over the body, not implicating the vital parts. This patient presents involvement of a great many regions, —the wrist, the hip, the knees, etc. There is the typical joint with its cold abscess, and she presents many other lesions. There is also a superficial tuberculosis of the skin. The patient has not had any particular line of treatment, but the house-physician concluded to try to cure the skin lesions by curetting and local applications. They have been curetted and iodoform ointment has been applied. This child has very extensive lesions, and yet she enjoys fairly good health. Strange as it may seen, no pulmonary condition has developed.

CHRONIC NEPHRITIS.

Case V.—This woman, E. S., is forty-six years of age; she has been sick a long time, and suffers chiefly from feebleness and dyspnœa. In this hospital, for some reason which I am unable to explain, a great many cases have an extremely low temperature. In this instance the temperature has been down to 94° F., and has not been above normal but once or twice. The attacks of dyspnœa I believe to be chiefly of renal origin, but they are aggravated by her feeble heart and the profound anæmia. We have been treating these conditions. The attacks have been somewhat relieved by

the administration of the compound spirit of ether and, sometimes, morphine. Diuretics and iron for the blood have been given. We trust that she will recover her strength and get about after a time.

CHRONIC ARTICULAR RHEUMATISM, ITS SEQUELÆ.

Case VI.—This patient, G. H., is forty-one years of age, and has been sick since June 12, but not helplessly so. During the past two months the abdomen has been swollen. This case resembles the one previously seen, in which there was a mild attack of articular rheumatism, followed by extensive involvement of the heart with concurrent symptoms. I find on examination that the heart's action is relatively feeble, rapid, and irregular; over the base there is a loud double systolic murmur. It is characteristic of an aortic lesion. Towards the apex there is a systolic murmur, and also a diastolic murmur, but not loud; so that I believe the patient probably suffers from some deformity of both the aortic and mitral valves. Although there is this extensive involvement of the valves, the heart is not much hypertrophied. This patient also suffers from congestion of the kidneys; the house-physician found a great deal of albumen present in the urine. She has, as you see, general anasarca. The first thing to determine is whether the chest contains fluid; if so, she must have relief in that direction. Yes; there is a certain amount of fluid in both sides of the chest. Over the lower part of the lungs the breath-sounds are absent; above, there are a good many moist râles, showing that the lungs are also moderately congested. Now, with all this ascites we naturally should think of cirrhosis of the liver; but the extensive heart lesion, the albumen in the urine, and the general anasarca are sufficient to account for all the symptoms. Of course, when the heart is so greatly crippled, the liver must be much congested and the portal circulation interfered with, and there results a tendency to ascites; so I shall not say that the lesion in the liver is the essential lesion. The temperature is subnormal.

The treatment consists in stimulating the heart to do better work, watching carefully for increase of the dyspnœa.

PLEURITIS SICCA.

Case VII.—This woman, J. W., thirty-three years of age, came into the hospital with a history of pleurisy. She suffered from

marked dyspnœa, so urgent that it was quite alarming. Although the signs on the right side were moderate, and were thought to be due to a circumscribed pleurisy, a thickened pleura, or a pleurisy with fibrinous exudate, yet we did not think it best to trust our diagnostic acumen without resorting to puncture. The needle revealed no fluid. So the dyspnœa must have been partly neurotic and partly due to pain. She has a dry pleurisy on the left side, and is doing very well.

DIABETIC GANGRENE.

Case VIII.—The next patient, J. B., aged fifty-seven years, came into the hospital suffering from a sore on one of her feet. An examination showed that one of the toes was the seat of a necrosis, and that there was a loss of vitality in the tissues. The diagnosis of diabetes, of course, immediately suggested itself, and an examination of the urine demonstrated the presence of sugar. Now both feet have become involved, and at the present time the process has gone on to desiccation, or drying up of the parts involved. Aluminum acetate is being used as a dressing. The line of demarcation is forming about the ankle. Interesting questions are: What is diabetes? and Why do the tissues behave in this way? Diabetes is a disease, so far as we know, characterized by the presence in the blood, and secondarily in the urine, of glucose. The origin and the causes are not well understood. Clinically, the important point here is that diabetes has a tendency to impair the vitality of the tissues, so that diabetics are liable to a great many complicating conditions, such as furunculosis, tuberculosis of the lungs, and, in extreme cases, to local gangrene. The probabilities are that diabetic gangrene commences with impaired circulation through disease of the blood-vessels. My own belief is that patients in good health otherwise may have an equal amount of impairment of the circulation and yet the tissues maintain their vitality. Diabetic gangrene is a condition due to vulnerability of the tissues and interference with the circulation.

Now, those of you who have been here before have seen cases of gangrene from other causes. The most extraordinary case we have had happened in a woman with spinal cord disease,—myelitis. She came complaining of pain over the course of certain nerves on each side of the pelvis, and we accounted for the pain on the sup-

position of some involvement of the cord. Soon after there was retention of urine, and then the characteristic symptoms of myelitis rapidly appeared. In the course of a few days she developed a large bedsore on the back, which the nurses thought to be due to neglect, and they felt bad. It was a case of gangrene due to disturbance of the nervous supply to the parts. The flesh for a time seemed literally to melt away. This was caused by the diminished trophic influence of the nerves. When the spinal cord disease was recovered from she regained the use of her limbs, the sore healed, and she left practically well. That case, with this one, makes a picture of two types. This case is due to a disease which tends to destroy the vitality of the tissues. In the other case the circulation was all right, the blood was all right; but the spinal cord, which presides over the nutrition, was out of order, and so the tissues melted away.

There is another type of gangrene, an example of which was the man with a popliteal aneurism, which was operated upon; the collateral circulation was not re-established, and the feet dried up and had to be amputated. That was a case of gangrene due to deprivation of blood to the tissues.

In old people we sometimes see a hardening of the blood-vessels resulting in gangrene, which pursues a course like that of the case of aneurism: the parts dry up, and the toe or foot attacked is lost.

These three varieties of gangrene are such as you will meet in general practice.

SENILE GANGRENE; CHRONIC GOUT.

BY GEORGE L. PEABODY, M.D.,

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SENILE GANGRENE.

Case I.—This man is a carpenter, a native of the United States, and is seventy years of age. He entered the hospital on November 6. He says he always enjoyed good health. He gives no syphilitic history. He continued at his work until one year ago. He presents no symptoms of diabetes or drug habits; he is a moderate drinker. One week before admission, while planing a piece of wood, working hard, he first began to have pain in the right foot, and there was a sensation of numbness in the toe. The pain gradually extended up the leg and is now near the knee. The lower extremity is mottled. His chief complaint is pain with numbness of the foot. The pulse, temperature, and respirations are substantially normal. The heart apex is in the fifth intercostal space three and three-quarters inches from the median line. Its action is regular in force and frequency. There are no murmurs. The pulse is regular, with a small increase in tension. The superficial arteries, as the radial and temporal, are thickened. The abdomen is soft and relaxed. The right foot is cold and bluish, with dilated veins. There is tenderness over the calf and some anæsthesia over the toes. There are areas of excoriations over the lower aspect of the leg. He came to us on November 6, and has been in the hospital two weeks. The pain has been only in the right lower extremity, particularly in the foot and lower part of the leg. He has had complete relief at no time, in spite of the fact that various local and general means have been addressed to the pain. Varying the position of the foot seems at times to make it easier. Applications of dry heat have not added to his comfort. Baths have given him but temporary relief. The administration of various narcotics and hypnotics—trional, chloral,

antipyrin, etc.—has been of little service. Morphine in one-quarter-grain doses did not diminish his pain. Codeine, one grain every three hours, has not afforded him relief. He has had given him morphine, one-quarter of a grain at night; this has been followed by about three hours' sleep. Now, what is the condition we have here to deal with? The least touch to his foot is painful. There is no swelling. The foot is reddish blue in color, and it shows an excoriation above the ankle the result of the application of ointment. There is no pulsation to be felt. There is a distinct elevation of arterial tension; he has an arterio-sclerosis. We, therefore, have one of the common causes of arrest of circulation in the arterial system. We believe that there is interference with the circulation in the popliteal artery; pulsations can be felt above but not below the popliteal artery. Anæsthesia is confined to the toes. The skin is cool. The discoloration is deepening day after day.

This is a beginning senile gangrene, and there is nothing we can do but to keep the limb under observation; we must stand by and watch with hands folded, unable to give him relief. We cannot re-establish the circulation, nor can we remove the obstruction. There is probably a thrombus, possibly an embolus. The thrombus probably occludes the popliteal artery, and there is now no circulation of blood in it. Although there is a great deal of pain, we have been able to give him only temporary relief.

(One week later.) This man with gangrene of the foot from an arterio-sclerosis has suffered intense pain, which is only temporarily relieved by the use of morphine, one-twelfth of a grain being given every four hours; at night he has had a hypodermic of morphine, Magendie's solution, eight minims; he gets but little relief from this,—a few hours' sleep. His local condition is rapidly growing worse. The foot is much mottled and the epidermis shows no reparative power. Rubbing the foot with certain ointments, bathing it, and applying a weak solution of opium (three drachms of tincture of opium to the ounce of water) give but temporary relief. The pulsations are absent from the popliteal artery, and the only remedy that I can suggest is amputation at the knee-joint or higher, depending upon the evidences of arterial obstruction. Dr. Weir has reached the same conclusion. The line of demarcation shows pretty well. If septic symptoms develop, he will be operated upon by Dr. Weir. His fever has been con-

tinuous, and now shows rapid fluctuations, which indicate a beginning septic condition. Before he came to us it was rarely above normal. During the first week it was 99° or 100° F.; during the second week it was practically the same; but during the last few days it has been symptomatic of a septic condition; it runs from 100° to 101° F., and it shows no tendency to abate; if this continues, we shall have to do an amputation.

(Two weeks later.) The patient shown you two weeks ago has been transferred to another sphere. The gangrene limited itself one-third the way down between the knee and the ankle-joint. In consequence of the limitation of the gangrene and the fact that the fever became high, we felt that we were justified in performing an amputation of the leg. On November 28, Dr. Weir amputated the thigh at its lower third. The popliteal artery was hard, cord-like, non-pulsating. The patient did not do well. The only symptom that was modified was the pain. He had a great deal of pain afterwards in the flaps, so that large doses of morphine again had to be administered; one-half a grain would not give him relief. The flaps sloughed. The fever became higher, and he died the fourth day after the operation. The autopsy showed a condition of the arteries such as you see here. This mass of tissue is the popliteal artery, and it was entirely blocked by a fibrous clot. The artery was much thickened. There were many calcareous plates. Smaller arteries below showed advanced stages of the process, the clots themselves were entirely decolorized and undergoing degeneration. The smaller arteries were the seat of degeneration.

CHRONIC GOUT.

Case II.—The next patient is forty-nine years of age, married, and a native of the United States. He was admitted to the New York Hospital on November 14. He has had scarlet fever and typhoid fever. Ten years ago he first noticed that there were pain, redness, and swelling in his left great toe. He has suffered subsequent attacks in the same toe. He has had similar pains in the right heel, and in both elbows and the small bones of the fingers of both hands, and in the right carpus. For about nine years there have been large lumps about the joints of his fingers and elbows and the right carpus. Three years ago the middle finger of his right hand broke down. Several years ago he had lead-poisoning,

with wrist-drop and concomitant symptoms; he was a printer, and so exposed to the handling of lead; here we can look to his trade for a cause of the poisoning. He has had no gonorrhœa for three years. Thirty years ago he had a chancre. He has some dyspnœa on exertion. During the past ten weeks he has suffered from heart symptoms. He has no œdema or headaches, ringing, or other ear symptoms. He drinks about two glasses of beer each day.

His present history shows that he has had during the past two or three days constant pain in the cardiac region. While away from the hospital the pain in the region of the heart spread over the liver, and he had a marked fear of death. Dizziness followed, and then he became unconscious. All this happened in the street. The ambulance was sent for. When he was brought into the hospital it was found that there were loss of power in both legs and cramps in his calves. His appetite was good. His bowels were constipated. His chief complaint was the headache. He was well nourished. The tongue was moist and coated. Nodules were found in both ears. The apex-beat was in the fifth space with pulsation in the epigastrium. The pulse was regular, small, and feeble. There was slight œdema of the feet and legs. The urine had a specific gravity of 1013, was acid in reaction, clear, contained albumen but no sugar, and showed numerous casts.

The treatment consisted of rest in bed with a hot pack. Salicylic acid was painted on the fingers and iodine was applied to the swellings. He slept fairly well, but in consequence of the pain developing in the left finger he has been given amylene hydrate. These tumors are freely movable. In the regions where he has had the most pain—the great-toe joint, etc.—there are no swellings. These joints are apparently normal in spite of the frequent attacks of gout. There is some thickening of the radial artery. So we have to deal with an individual who is suffering from arterio-sclerosis, and who has an hypertrophy of the left ventricle. He has an intensified aortic second sound. He also has a chronic nephritis, largely interstitial, with an abundance of urine and hyaline casts. He has, too, chronic gout with deformities. He has had attacks of angina pectoris, well pronounced, the result of an arterio-sclerosis in the coronary arteries. It started with the attack of chronic lead-poisoning. Lead is a common cause of arterio-sclerosis. He has not been a high liver, nor has he taken more beer than the average

man. Do not look for the blue line on the gums in these cases of chronic lead-poisoning; it is not always present.

The management of this case resolves itself into the treatment of the arterio-sclerosis. We cannot treat the chronic gout, but the acute attack we can treat locally. For the short time he is to be in this hospital I would rather not prescribe for the gout, but rather direct attention to his arterio-sclerosis and the local manifestations by hot packs, purging, and sweating. If pain in the joints does not subside under the salicylates, then, of course, we shall give colchicum.

(One week later.) All the symptoms subsided under the administration of colchicum wine, ten minims given after meals; he is now able to sit up in bed.

Neurology

A CONTRIBUTION TO THE PATHOLOGY AND TREATMENT OF EPILEPSY.

BY FR. RUBENSTEIN, M.D.,
Of Berlin, Germany.

In the early days of medical science diseases were described merely as bundles of symptoms. No attempt was made to refer symptoms to individual organs and their pathological alterations. The idea of localization was unknown even at the time of Morgagni and his great work " De Sedibus et Causis Morborum."

Then for the first time arose the question as to the seat of epilepsy, a question which is still unanswered; and it has therefore become customary to speak of the falling sickness as a malady *incertæ sedis,*—of unknown location.

At present, in the era of pathological and anatomical medicine introduced by Rokitansky and Virchow, we are in the habit of giving the name of neuroses or functional diseases to all those changes in the nervous system for which a palpable anatomical cause cannot be found. It is in this sense that we speak of epilepsy as a neurosis. Mention will be made further on of experiments made to locate the disease by isolating an area capable of artificially exciting epileptic convulsions.

I hope to be able to show that in consequence of the peculiar structure and function of the cortex we may confidently expect to locate a source of some of the symptoms of epilepsy that is entirely independent of structural or anatomical changes.

This brings us to a field in medical science in which technical nomenclature has lost much of its accepted meaning, and in which the notion anatomical insensibly merges into that of the functional.

Language at best often becomes a source of error in science, especially in the science of natural objects. In dealing with material things we should describe less and give freer range to the imagination.

According to the pathological anatomical doctrine proclaimed by Virchow, there is for every disease an exact and definite anatomical cause; and failure to ascertain this cause, as, for example, in the so-called neuroses, must be ascribed not to its absence, but to imperfect methods of investigation. Neglect of functional diseases has been a necessary consequence of this point of view.

This doctrine may, however, be combated with its weapons of exactness. We may say that in the neuroses—hysteria, neurasthenia, epilepsy—the pathological anatomical basis is only hypothetical. I am inclined to regard this as true also of certain mental diseases; and I believe that the investigation of neuroses has been hampered by unjust anatomical generalizations. They were ignored by the leading pathological anatomists on account of their inability to find a place for them in their systems. For this reason we must study their pathology in a different way; that is to say, as a functional phenomenon, by ascertaining the laws of their origin, development, and decadence.

Perhaps we are on the threshold of a new era of medical science; an era of functional pathology based upon the fact that epilepsy, which has ever been a sphinx for medicine, becomes clear in all its etiological relations when studied as a purely functional disorder.

From the infancy of medicine the convulsive stage of epilepsy, according to Binswanger,[1] has been regarded as an essential feature of that disease. At the present time the highest authorities are convinced that the convulsion is but one link in a chain of many symptoms, physical and psychical; that the isolated convulsion is to be regarded merely as an incident in the course of the development of a chronic disease involving the entire central nervous system. This point of view of Binswanger[2] is opposed to that of Féré,[3] who, in the opinion of the first-named author, has discarded the modern acceptation of epilepsy as one disease, regarding it as a group of complex symptoms. These symptoms Féré divides into four classes, which may be present singly or in combination. The combined groups are more frequently observed. Binswanger be-

lieves that while Féré has greatly amplified the symptomatology of epilepsy, he has been unable to establish generalizations of value. He has collected stone and timber, but has built no house.

Féré calls epilepsy a neurosis because since the days of Hippocrates no seat has been found for it. Binswanger [4] regards it as a neurosis because it is accompanied by no alteration in the anatomical structure of the nervous system. This author [5] also emphasizes the impossibility of distinguishing between neuroses and changes of nerve function due to material alteration in the nerves themselves.

The higher the place of a system in the scale of organic functions, the more quickly does it respond to the disturbing influence of slight shocks.

As the equilibrium of the central nervous system is more delicate and sensitive than that of any other bodily organ, we are justified in the assumption that the tissue-changes giving rise to epilepsy are variable and transient in character, easy to check but difficult to prevent.

Such considerations make it no contradiction to regard epilepsy as a neurosis, and at the same time to claim for it a definite location. To say, with Binswanger,[6] that the whole nervous system participates in the epileptic process, is to admit that it must be *incertæ sedis*. Nevertheless, the experiments of Fritsch and Hitzig, H. Munk, Flechsig, Ferrier, Gowers, Hughlings Jackson Luciani, Horsley, and others enable us to assign a definite location to the source of muscular convulsions. As to this matter there is, however, a wide divergence of opinion among investigators. Upon their studies of anæmic convulsions in the lower animals Kussmaul and Tenner founded the vasomotor theory of epilepsy. Then came Nothnagel's investigations upon the cramp centre in the medulla oblongata on the floor of the fourth ventricle. Together they promulgated a spinal theory of epilepsy; that is to say, they thought that the convulsions originated from a definite centre,—a focus,—in the medulla oblongata. Then attempts were made by Haig [7] and others to explain epilepsy as an intoxication. They spoke of a toxæmic epilepsy induced by the poisonous action of uric acid, lead, alcohol, uræmic conditions, and the like. But the convulsions of toxæmia and anæmia do not follow a certain definite sequence as do (mostly) those of genuine epilepsy; they not only

pursue a different course from those of true epilepsy, but they also present different types and throw little light upon the disease.

Unverricht [8] experimented on dogs by irritating the cortex with the electric current. By an extensive series of experiments he was able to show, contrary to the spinal theory of Kussmaul and Nothnagel, not only that the epileptic convulsion originates in the cortex, but also that it is the cortex that determines the further development of the disease. Each complete fit is composed of two halves which reflect the subsequent irritation of the two hemispheres of the cerebrum. Unverricht argues, moreover, that in man epilepsy must be of cortical origin, as it arises from that region in the less highly organized dog. He shows the identity between his experimental cortical epilepsy and genuine epilepsy in man. The only difference between them is in the severity of the convulsions, and he does not hesitate to designate true epilepsy as a cortical process. The irritation of a circumscribed area of the cortex transmits shocks to one part of the nervous system after the other. This shock interferes with the vegetative functions, the circulation, respiration, and different secretory organs, and gives rise to psychical symptoms, such as maniacal fits and exhaustion, tongue-biting,—in short, it presents all the characteristics of the epileptic fit in a typical way. Unverricht declares that no analogy could be more striking. Not only do the first convulsive movements come from the cortex, but the cortex also maintains the fit during its subsequent stages.

The so-called epileptic equivalents,—loss of consciousness, petit mal, headache, waywardness of character,—upon which much stress has been laid of late by Lombroso [9] and his followers, Unverricht regards merely as complications whose presence does not indicate the existence of epilepsy, the cortical convulsions being alone decisive. Epilepsy will probably have become nothing more than a symptomatic designation by the time we shall be able to demonstrate the causes of epilepsy,—*i.e.*, of the convulsions in the concrete case.

Unverricht does not think that the occurrence of infracortical (medullary) convulsions in man is yet proved. He believes in their existence in man only from analogy with the experiments of Kussmaul and Nothnagel in animals. In opposition to these views of Unverricht, Binswanger [10] and Jolly [11] have adopted a theory

of mixed infracortical and cortical genesis of the epileptic fit. Binswanger says that the irritation is first localized in a certain region of the cortex, from which it is conveyed by circuitous routes to the more deeply seated infracortical parts of the central organ, situated partly in the medulla and partly at the base of the brain. This opinion is based upon experiments in which infracortical irritation was applied. Jolly says in support of his theory that the exclusively cortical doctrine of Unverricht is untenable, for spasms are observed in muscles paralyzed by cicatrices involving their cortical foci, and therefore infracortical irritation must be accepted as the cause of these spasms.

The opinions of Binswanger and Jolly are confirmed by the experiments made by Prus.[12] He shows that the irritation of the cortex is the primary process, and that this irritation is conveyed to the infracortical motor apparatus by special motor channels, which transmit both the reflexes originating in the cortex and at the same time the complicated (spontaneous) movements.

As regards the etiology of epilepsy, there are two generally accepted views: 1. That there is a peculiar condition existing in the epileptic brain, called the epileptic alteration, or the spasmophile or convulsive state, this being a spasmodic disposition of the brain-substance. The nature of this disposition and the circumstances that lead to it are unknown. This has been referred to by von Bergmann,[13] and is mentioned in Binswanger's[14] textbook on epilepsy. 2. The second etiological point generally agreed upon is the necessity of a direct exciting cause for the provocation of the single epileptic paroxysm. The art of diagnosis and the efficacy of medical and surgical therapeutics depend upon the discovery of the true relations of these two factors, the former of which I call the internal, the latter the external, irritation. We may reasonably hope to cure the epileptic when the determining causative moment is paramount. And I doubt not that we will one day also be able to influence the inherent disposition, the internal cause of epilepsy.

The internal irritation, neuropathic or psychopathic disposition (Griesinger), is shown by the circumstance that trifling injuries of the nervous system which occasion no harm to a sound nervous constitution lead to grave and chronic nervous troubles. But so long as we do not understand the mechanism of the brain and its

cortex, so long as we are ignorant of the laws of irritation, such expressions as neuropathic disposition are mere words, and serve only as a cloak for our ignorance.

The epileptic disposition may be (1) hereditary, (2) developed in utero, (3) or acquired after birth.

1. As for the first category, the germ of the individual has been exposed to some pathological influence, such as intoxication of the parents by alcohol, lead, morphine; infectious diseases, as syphilis, tuberculosis; by anæmia, leukæmia, chlorosis, diabetes, gout, arthritis deformans, or diseases of the organs of generation. The consequences generally manifest themselves as constitutional infirmity or maldevelopment of the nervous system. For the most part these troubles are only functional, visible, palpable deformities being rare.

2. In the second group the germ is primarily normal, and the pathological influences are to be referred to the mother. The first two forms may be combined.

3. The troubles of extra-uterine origin are serious in proportion as they appear early in life. Among the predisposing factors may be mentioned mental and bodily overwork and psychical disturbances of the mother during pregnancy. In this category also belong intoxications, infectious diseases, traumatic lesions, and psychical emotions, such as joy, anger, fear, and sorrow.

To distinguish between predisposing and exciting causes is very difficult and often impossible. Exciting factors may be found in infectious diseases, in a full bladder (I regard this as the cause of the many epileptic fits which occur in the morning towards the end of sleep), in intestinal parasites, in otitis media, in neuromata situated on the peripheral nerves, in scars on the skull and on the extremities. It has also been said that phimosis may be an exciting cause of epilepsy.

It has been observed that after epilepsy has existed for some time the convulsions take place without any exciting cause. In the early attacks a causal factor is indispensable. It is for this reason that many of the surgical measures resorted to for the cure of epilepsy are ineffectual.

When there are scars, neuromata, or other palpable exciting lesions we should insist upon operating soon after the development of epileptic seizures arising in connection with them, lest the exter-

nal become established as an internal cause, which would render surgical interference useless.

Another point to be remembered is the fact that the different investigators have ignored the existence of an etiological factor of a dynamic nature.

Kussmaul and Tenner, as we have seen, formed a vasomotor theory of epilepsy; Nothnagel, a medullary; Unverricht, a cortical. They are not so far from the truth as those authors who base their opinions of the disease upon etiological considerations, and who have worked out infectious, toxæmic, anæmic, hyperæmic, chemical, and mechanical theories of epilepsy. Would it not be better to combine all these theories, each of which naturally claims infallibility, into the common notion of irritation? Different etiological moments give rise in the brain to pathological irritation of the same sort whether the cause be mechanical, chemical, or psychical,[16] or due to hyperæmia or anæmia of the brain. The *tertium comparationis* is in any case irritation. The numerous and contradictory etiological propositions are thus reduced to but one. In adopting this dynamic mode of observation I am following in the footsteps of Francis Glisson, John Brown, Haller, O. Rosenbach, and J. Wolff. La Mettrie also adopts the same course in his standard work " L'homme machine."

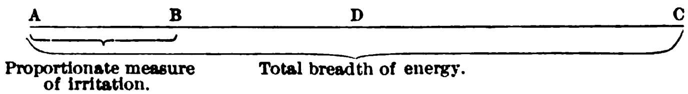
We have devoted our attention long enough to the material and the structure of the machine as well as to their disturbances. Now for an era in which the function of the organs and of the system as a whole will be the object of our philosophy and our experiments. Our theory of the pathology of epilepsy promises little therapeutically, but it furnishes a more rational point of view.

The central nervous system of man, according to my theory of irritation, may be compared to an accumulator of electric energy, which can be alternately charged and discharged. I believe that the human brain is charged during sleep, and that it is discharged to a certain point, but not to complete exhaustion, during the day by the various functions of the body, especially by the psychical and muscular processes. I may, in this connection, refer to the experiments made by A. Mosso, of Turin, and described in his book " On Exhaustion." [17] When the central nervous system is charged, it possesses a certain definite amount of nervous energy which varies in each individual brain. It is this congenital and inherited

capacity of the brain that establishes man's physical and psychical limitations. These limitations may be modified to a certain extent by measures to which reference will be made further on.

To set the organism to work, a shock or stimulus must be imparted to it from without. This shock is furnished by the irritation, the source of which must always be a material one. Irritation tends to destruction; its form and intensity must, therefore, be so modified as to save the organism from destruction.

The first law of organic irritation, established by Glisson,[18] is that a certain relation exists between the degree of irritation and the tension of organic energy. The greater the energy the stronger the necessary irritation. Nervous energy may be measured by the degree of irritation which is just sufficient to produce response. We see in life that men with a hereditary disposition to diseases of the nervous system are easily overcome by alcohol. The hereditary disposition, in my opinion, is nothing more than a low degree of nervous tension,—a small amount of nerve-energy. This law may be represented by a diagram:



Let the line AB represent the threshold of irritation. Response to irritation is excited by stimuli equalling AB, no weaker stimuli being operative. In sleep, the external irritation being in abeyance, that arising from within suffices to maintain life and permit sleep, but it does not possess the threshold intensity. The line AB expressing the minimum operative irritation, the line AD may be taken to represent its maximum. The distance BD I have called the breadth of irritation, for if the irritation exceeds that amount over-irritation and finally paralysis follow; that is to say, slight irritations excite the manifestations of life, greater ones exaggerate them, while excessive irritation destroys life. This law holds good throughout the whole organism.

The operation of the laws of nervous irritation is well illustrated in chloroform anæsthesia. Chloroform, which is chemically related to alcohol, when administered in the usual way by inhalation first paralyzes the highest functions of the cortex, con-

sciousness and the ability to stand erect. This is followed by a stage of a quite contrary character, one of great muscular excitement, and this in turn is succeeded by paralysis. The arms flap loosely from the shoulders, the tongue sinks,—tolerance has been reached. If the administration of chloroform is carried beyond this point, the paralysis soon extends to the centre in the medulla oblongata which presides over circulation and respiration, and death follows.

This brings us to a third and important law, that of the different irritability of the several parts of the central nervous organs. Were it not for this property general anæsthesia would never have been available for surgical purposes. The cortex manifests the greatest sensitiveness to irritation; the centres of circulation and respiration, whose functions are earliest developed in the embryo, have the least; they can withstand the severest shock. When in a given individual slight irritation causes excessive reaction of the nervous system, we may infer either that there is a deficiency of hereditary energy, and consequently excessive irritability, or that the nervous energy is normal in amount, but that a part of it has been exhausted by what I have designated as irritation arising from within. I have shown that the external irritations that cause epilepsy either alone or because of a predisposition on the part of the individual may in time become internal. From this well-established fact it follows that the total amount of energy diminishes in proportion as the internal irritation increases; that it is less by so much.

The internal irritation may be of different kinds; it may be chemical, as in the syphilitic, gouty, and uræmic; or mechanical, from traumatism with depression of bone or fracture of the skull with sharp projections; or it may arise from mental shock.

Relatively to the trunk of the brain, the pons and the medulla oblongata, the cortex may be regarded as situated externally, and irritation arising from it may have all the characteristics (for those trunk organs) of external ones. Another important law of irritation will be referred to in the discussion of therapeutics.

I think I have shown that the hereditary disposition consists of a small degree of nervous energy which renders its possessor exceptionally susceptible to the slightest shocks from without, these soon causing loss of consciousness, inability to maintain the upright

position, and undue muscular action. The sequence of these phenomena closely resembles the various stages observed in the induction of chloroform anæsthesia. Its successive stages are identical with those of an epileptic seizure. We have the coincidence of paralysis and excitation, which seeming contradiction is easily explained by the law of the unequal irritability of different cerebral regions, which I was fortunate enough to discover some years ago, and which von Bergmann, of Berlin, defines in the third edition of his work on the surgical treatment of brain diseases (page 1). In the so-called stage of excitement of chloroform narcosis which occurs soon after the commencement of the inhalation of the drug I see the type of an epileptic convulsion, and I am surprised that this perfect analogy has not been previously recognized. This stage of excitement, which is very troublesome for the surgeon, is of short duration when chloroform is administered in the usual manner; but it would be possible to prolong it by giving the chloroform in such a way as to avoid paralysis of the muscular centres. The analogy extends still further, for the stage of excitement is most marked in alcoholics; a post-narcotic state is sometimes observed that offers many points of resemblance to the *status epilepticus,* and when the administration of the drug is repeated absolute insensibility is more quickly induced than when it was first given. This is precisely what occurs in epilepsy. Each attack prepares the way for another, and with recurrence the paroxysms become more severe and less amenable to treatment.

The study of chloroform narcosis teaches us still more. If we accept the theory of Unverricht, that the convulsions are essentially cortical, we see that a drug which induces loss of consciousness and inhibits the ability to maintain the upright position,—causing arrest of function and paralysis,—acting on the motor areas, may also produce convulsions; in other words, stimulation, overaction.

From this, if our laws of irritation do not mislead us, it is obvious that the motor areas of the human cortex, the convolution of Rolando or gyrus præcentralis, is less irritable than the region that presides over consciousness and the maintenance of the upright position.

The amount of energy is directly proportionate to the toleration of irritation. The greater the energy the greater the degree

of irritation that can be withstood without irritation, and *vice versa.*

The reason for this is, I think, to be found in the history, the phylogenetic history of the human cortex. The centres of motion, the motor region, are older than the centres controlling consciousness and maintenance of the upright position, for I believe that the ability to stand erect is also a cortical function and one of the youngest, and the younger the function the greater its irritability.

These views, which can no longer be regarded as purely theoretical, are further confirmed by what we observe in alcoholic intoxication of the brain, in which consciousness and ability to stand erect are first affected.

The theory of different irritability explains the pathology of incomplete epilepsy, the *petit mal,* and the single convulsion affecting sometimes only one muscle, as of the thumb, of the thigh, of the eyelid, and perhaps the cheek, without loss of consciousness, and also such attacks as cause temporary loss of consciousness but no convulsions.

The irritation in the last-mentioned cases extends only to the field of consciousness, not being of sufficient intensity to affect the muscular foci of the cortex. The significance of these seizures is grave, and those in whom they occur should be shielded as far as possible from all that tends to excite epileptic attacks,—overwork, outbreaks of passion, use of alcohol, etc. For we know that in the so-called Jacksonian epilepsy, in which isolated motor convulsions occur arising from the anterior central convolutions, the spasmophile state of the entire brain gradually develops, so that the primarily cortical epilepsy merges into the genuine epilepsy of the authors.

Permanent irritation arising from a morbid process in the gyrus præcentralis reduces the energy-equivalent of the whole nervous system. Energy being exhausted, the brain is unable to repair its losses as is its wont during sleep, on account of the presence of that source of continued irritation.

We thus gain an insight into the nature of that *magnum ignotum,* the epileptic, convulsive, or spasmophile state of the cortex. We find it to be identical in its essence with the hereditary disposition. Its effect is always to diminish energy and cause a susceptibility to irritations which a normal energy could easily withstand.

I therefore think myself fully justified in saying that there is no hope for the science of epilepsy, for its pathology, or for its treatment, save in the functional dynamic theory of energy. All difficulties vanish before it, and it fully explains the various forms and complications of this disease.

The foregoing considerations may be summed up as follows:

1. Epilepsy and its genesis can only be understood from a functional point of view.

2. The phenomena attending the administration of narcotic drugs is of great value in the study of the pathology of epilepsy.

3. Different regions of the brain possess different degrees of irritability. The younger (phylogenetic) the brain organ the greater its irritability. For this reason consciousness and the ability to stand erect are first affected in cases of brain lesion. The centres of circulation and respiration have the greatest energy and succumb last to irritation.

4. The hereditary disposition may consist either in the presence of an abnormal irritating substance in the brain tissues, or in deficient energy of the nervous elements, energy being taken in a mechanical sense. Both these dispositions are practically the same, for each amount of internal irritation diminishes by so much the total breadth of irritability which the nervous system is able to put into the life struggle.

5. The spasmophile condition of the brain, the true nature of which has been until recently unknown, consists in a state of diminished energy and correspondingly high irritability of the central nervous system that may be likened to a state of exhaustion. We cannot give a more satisfactory explanation of this condition.

6. The great desideratum in the diagnosis of epilepsy is to separate the external from the internal irritating moments, and to attribute its due part to each. The prognosis, especially of operative treatment, will be the more favorable in proportion as the external causes predominate.

Treatment.—As regards the treatment of epilepsy, I have little to say. I do not, however, consider therapeutics so powerless as do some authors. Of course, an exact diagnosis must be made as to the form of the disease in any given case; whether it is reflex, partially cortical, wholly cortical, or traumatic, and, when traumatic, whether the lesion is in the head or on an extremity. Careful

examination of the body must be made in every case for any lesion which might be regarded as an epileptogenous zone.

Operative treatment, which promised much in the light of physiological experiment, has proved somewhat disappointing even in the hands of the best surgeons. Von Bergmann [19] says that in cases of general traumatic epilepsy potassium bromide will prove more helpful than operation. Of four cases of Lucas-Championnière's,[20] published by Dumas, a year had elapsed in only one since the supposed recovery. Von Bergmann thinks such data of little value. He also had some failures in operating upon cases of partial traumatic epilepsy. He regards those cases as best fitted for operation in which a visible scar in the integuments of the skull corresponds not only to the place of the original lesion, but also to the cortical focus from which the convulsions take their origin. Graf [21] has collected thirty-five cases of this kind, with but two recoveries (equal to three and six-tenths per cent.) lasting more than three years. Some cases are cured by osteoplastic protection of the skull defects; others (Kocher [22]) by opening the skull after the impaction of bone. From this it is evident that there are no certain anatomical or pathological rules, but that the *tertium comparationis* is the functional condition after irritation.

Horsley [23] suggests faradic irritation of the suspected area of the cortex to determine whether the pathological focus is really the source of the convulsions. The electric current should not be strong enough to provoke contractions from the motor regions of the brain. Sahli [24] thinks that we may operate with some probability of success in pronounced cases of cortical epilepsy. Nevertheless there is no uniformity of results even in these cases. He anticipates better results with improvement in surgical technique, more exact localization by means of electrical irritation, and careful clinical observation.

What is, then, the bearing of these laws of irritation upon the treatment of epilepsy? This question can be answered by citing another law of irritation that has already received general acceptation. It is possible by irritations which are increased in definite progression to enlarge the congenital and hereditary breadth of irritability; that is, to strengthen the energy of the nervous system. This law of graduated irritation involves the whole scheme of education both of body and of mind.

If a man should come to riper years with the nervous irritability of childhood, he would stand in constant danger of death as a result of some severe irritation. By gradual irritation, however, he may become one of the fittest to survive. It must be owned, however, that gradually increased irritation has to be applied with some care, for when too strong it provokes other troubles. Then, again, there are brains that are hopelessly bound to their primary formula of energy. They cannot be excited in any way. They are degenerate, and had best be left alone.

How then is gradually increasing irritation to be applied? Best, I think, by means of water beginning with a temperature of 26° Réaumur and reducing to 18°. Electricity may also be employed. Nerve-stretching has been used to excite irritation. Two cases are mentioned by Erlenmeyer.[25] Beurnier had a patient with congenital epilepsy in whom the attacks were preceded by distress in the arm and a feeling of oppression. He stretched the median and cubital nerves in the upper third of the arm. After this the number of paroxysms diminished from ninety to eighteen per month, and they also became less severe. Langenbuch[26] mentions a case in which he stretched the median nerve for grave traumatic epilepsy in a man thirty-two years old, who had fallen from a roof and had remained unconscious for several days. The return of consciousness was followed by numerous epileptic convulsions. Traction on the nerve invariably produced a spasm of the corresponding half of the face, and the pulse became slower, an evidence of brain irritation. Morton,[27] in a case of reflex epilepsy of the right side of the body, resorted to nerve-stretching (medianus, ulnaris, et cutaneous internus) with very little effect. These therapeutic measures are unimportant, and they cannot be regarded as proving my theory; but as they were undertaken at a time when the laws of irritation, as I have announced them above, were unknown, they should be repeated in an exact and scientific manner, especially the application of that commonest physical agent, water. I prefer water as a means of gradual irritation because, in the first place, it is to be had everywhere; and, secondly, because by it we may directly reach the central nervous system presiding over the innervation of the skin.

If my laws of irritability are well founded and their bearing upon the symptoms of epilepsy and their genesis be fully under-

stood, I feel that I may predict the success of this treatment, especially in cases of what is called genuine epilepsy, the unknown, the spasmophile disposition of the brain whose nature is the object of so much earnest inquiry.

The pathological anatomical era preceded the etiological or bacteriological era of Robert Koch and his pupils. The trend of these methods was to direct scientific investigation from man to bacilli, spores, and micro-organisms of all kinds. Now, in my opinion, the reason why a man becomes sick is not a simple but a complex one. There are some predisposing factors in the individual himself which are the most potent, and there are some acting from without which are only to be regarded as exciting causes which would be of no effect if the internal agents were entirely wanting. Now Koch directed investigation exclusively to the surroundings of man, identifying some bacteriological causes of disease with the disease itself; that is to say, he considered what was but an etiological factor of disease its sole cause. And so of the pathology of epilepsy; it has its key, as we have seen, much less in peripheral affections and lesions of the nerves and other organs than in the internal modifications of irritability, which, once established, have never been removed, and have often thwarted the well-directed efforts of the most skilful operators and brain surgeons. I therefore believe most firmly that epilepsy should be attacked therapeutically not from without, but from within, and I hope that I have shown how this may be accomplished.

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RIGIDITY OF THE SPINE WITH ANKYLOSIS AND DEFORMITY OF OTHER JOINTS.

CLINICAL LECTURE DELIVERED AT THE ARAPAHOE COUNTY HOSPITAL, DENVER, COLORADO.

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Gentlemen,—Through the courtesy of Dr. S. D. Hopkins, I shall to-day call your attention to a number of interesting, rather rare, and curious cases. Some of the patients whom I shall bring before you have been in the hospital a number of years, one for a period of not less than nine.

They all present the symptom-group of rigidity of the spinal column, ankylosis, and deformity of other joints. Rigidity of the spine has been discussed by so many eminent writers, especially neurologists, during the last few years, that were you full-fledged physicians I should feel like apologizing for bringing these cases to your notice. During your student days, however, the class of cases receiving the most attention from the profession is one with which you should become entirely familiar.

Case I.—James A. M., white, twenty-eight years of age, farm-hand until his seventeenth year, for the last two years hotel boy, came to Colorado during the summer of 1888, and was admitted into the Arapahoe County Hospital January 17, 1891, complaining of pain in left hip and thigh.

The family history, so far as the patient knows, is good, or at least negative.

Personal History.—The patient as a child was healthy; he had measles and whooping-cough, from both of which he made an excellent recovery. During his tenth year he suffered from malaria for some months. With these exceptions he had not been sick before coming to Colorado.

During the fall of 1890 he began to suffer from shooting pain

in the left thigh, extending from the hip to, but not below, the knee. He does not remember whether the pain followed exposure to cold or not. After this attack he was lame, but he does not think that the leg was stiff at any of the joints. The pain was less while he was quiet.

An examination made February 1, 1891, showed the patient to be anæmic, thin, and rather under size. There was no evidence of disease of the cord or brain. The reflexes, superficial and deep, were about normal, except that possibly the knee-jerks were slightly increased, the left to a greater degree than the right. He complained of pain in the left thigh, hip, and lumbo-sacral region of the back, also of stiffness of the leg at the hip-joint. Motion was decidedly limited at the left hip-joint, more apparently on account of pain and muscular rigidity than from ankylosis of the joint. With gentleness the left knee could be crossed over the right, and quite extensive movements were possible at the hip-joint. The adductor muscles of the left thigh were contracted, rigid, and unyielding, so that normal adduction of the leg was impossible. No areas of anæsthesia or hyperæsthesia were found; neither was tenderness discovered over the spine, nor did he complain when firm pressure was made with one hand over each ilium, so as to crowd the bones against the sacro-iliac joints. A careful examination by the rectum revealed nothing abnormal. The urine contained neither albumen nor sugar, and none of the viscera presented evidence of disease.

He was placed in bed, and blistered over each sacro-iliac joint; he was given sodium salicylate for a time, afterwards potassium iodide and tonic treatment, and urged to take as much food as possible. The pain soon lessened, but it was observed by May 1, 1891, that movement of the right leg at the hip was also becoming restricted on account of contraction and rigidity of the adductor muscle. The patient could now walk with short steps only, and it was impossible for him to raise either foot the normal distance from the floor.

Drs. J. C. Davis, E. J. A. Rogers, Clayton Parkhill, and George B. Packard saw the patient in consultation with me early in May. After careful and repeated examinations with and without an anæsthetic they were, with one exception, unwilling to make a definite diagnosis.

The condition at that time presented but few symptoms. These were, limitation of all the movements of the legs at the hips, especially those of abduction, on account of the contraction and rigidity of the adductor muscles, which did not yield under anæsthesia, pain in each hip-joint and in the lower portion of the spine. There was absence of the usual symptoms of hip-disease and of organic nervous lesions.

One of the consultants thought the condition might possibly be Paget's disease. All agreed that if the case was one of chronic progressive osteomyelitis it was most atypical.

During the patient's first year in the hospital his general health was fair, although his appetite was capricious and he lost about twenty pounds in weight. In January, 1892, one year after his admission, the pain in the hips, thighs, pelvis, and back had greatly diminished, but walking even with the aid of crutches was impossible on account of the contraction and rigidity of the muscles moving the legs at the hips, the adductors still being the most affected. He remained in nearly the same condition until early in 1893, when he began to suffer from severe pain in the knees and ankles. These joints became swollen and tender. During the next two years his condition grew gradually worse, but the pain in the knee- and ankle-joints lessened. All motion was lost at the hip-, knee-, and ankle-joints. The thighs were fixed by ankylosis nearly at right angles with the body, and the legs at right angles to the thighs. Early in 1895 severe pain was experienced in the cervical region of the spine. It extended downward from the head to a point opposite the spines of the scapulæ. This region of the spine was very tender and slightly swollen. The entire cervical region became rigid and the head fixed, the face being rotated to the left and the chin drawn downward towards the left shoulder. After a few months the pain ceased, and this symptom was in comparative abeyance for a year and a half.

In the fall of 1896, severe pain was felt in the left wrist-joint and in most of the joints of the fingers of the left hand. The pain in these joints was more acute than it had been in any other place. There were great swelling and tenderness from the first, so that no attempt was made to move the left hand. At the same time there was slight pain in the left elbow, and movements at this joint have since been limited. After a period of about six months the pain

and swelling in the left hand and wrist began to diminish and muscular wasting in the hand, especially affecting the interossei, and the external surface of the forearm became apparent. The muscular atrophy has much the appearance of that which follows chronic articular rheumatism. The nails of the index- and ring-fingers came off, but were renewed.

The patient has experienced pain in nearly every joint of his body, but none of a severe nature in the left shoulder, nor in any of the joints of the right arm. Since the spring of 1897 he has felt no pain, and the positions of the joints have changed but little. In April, 1898, he said that he felt better than he had at any time since he entered the hospital.

Examination, April 18, 1898.—The right foot is thrown outward at an angle of about forty-five degrees to its normal position. The toes are plantar-flexed to an extreme degree. There is still ability to move the great and the two adjacent toes to a slight degree. The great toe and the one next to it are drawn together and turned in; the remaining three are also drawn together, but are thrown outward. The entire foot is slightly enlarged, and is hard and board-like to the touch. The foot is immobile at the ankle-joint. The joint itself is enormously enlarged and presents a condition of valgus. The tibial bone is not carried outward with the foot, but on account of the disorganization and relaxation of the ligaments the fibula is displaced outward and is widely separated from the tibia. The knee-joint is enlarged and deformed; the leg is immobile, and bent nearly at right angles to the thigh. The destruction of the knee-joint seems to be less complete than that of the ankle. The thigh is strongly adducted, so that the inner side of the knee-joint rests against its fellow and has caused a sore by pressure. The leg at the hip-joint is firmly ankylosed in the position shown in Fig. 1. There seems to be no motion at all at the right hip-joint.

The condition of the foot and leg is nearly the same on the left as on the right side, except that the left foot is inverted; there is varus instead of valgus, and the left knee shows greater disorganization and deformity than the right one. The bones at the knee are completely dislocated, the joint thoroughly disorganized and ankylosed. There seems to be a little more motion at the left hip-joint than at the right, especially in abduction and adduction. The

Case I.—Fig. 1.—Complete ankylosis of the spine. Malposition of the head. Deformity resulting from disorganization and ankylosis of the knee-, wrist-, hip-, shoulder-, and ankle-joints.

Case II.—Fig. 2.—Rigidity of the spine, muscular atrophy and ankylosis of the ankle, knee, hip, and vertebral articulations.

Case III.—Fig. 3.—Immobility of the lumbar portion of the spine due to rigidity of the lumbar muscles. Ankylosis of the right hip-joint, contraction of adductor muscles of the thigh.

Case III.—Fig. 4.—Deformity of the spine caused by rigidity of the lumbar muscles.

joint is probably more completely disorganized than its fellow on the right side.

The spine from the sacrum to the middle dorsal region is almost absolutely straight, and its normal curves are obliterated. The spine is fixed and cannot be bent in any direction. The sacral region seems a little more prominent than normally. The spine in the upper dorsal and cervical regions is rigid, bent forward, and rotated to the left, the greatest curvature being in the cervical portion. The head and face are thrown forward and to the left, so that the chin is over the outer portion of the clavicle. The sterno-cleido-mastoid muscle is relaxed on the side from which the head is turned, but the posterior cervical muscles on this side (the right) are rigid. On the left side the posterior cervical muscles are relaxed, but the sterno-cleido-mastoid muscle is rigid on account of its being stretched by the abnormal position in which the head is held by the deformity in the cervical region of the spine.

Both temporo-mandibular joints are partially ankylosed, so that the teeth cannot be separated for more than about one-quarter of an inch. At one time it was difficult to administer food on account of the pain experienced in trying to separate the teeth. The condition of the temporo-mandibular joints was not mentioned in the history. The involvement of these joints began about the time that the cervical region of the spine was first affected. This was early in 1895. The masseter muscles also appeared to be wasted to some extent.

There is partial ankylosis of the left shoulder-joint, so that the arm can scarcely be raised to a right angle with the body by forced movement. The left deltoid muscle is greatly wasted. The right shoulder-joint is slightly restricted in motion, and involvement of the left elbow-joint limits the rotation and extension of the arm. The elbow, wrist, and hand of the right side are unaffected.

The left hand, immobile at the wrist-joint, palmar-flexed and rigid, is held at an angle of about forty-five degrees from the line of the forearm. The thumb is greatly adducted at the second joint, which has undergone serious disorganization. The fingers at the metacarpo-phalangeal joints are thrown backward. The ring and little fingers are freely movable at these articulations, but the middle finger has only a limited range of palmar flexion. The index-finger is dislocated backward on the dorsal surface of the

metacarpal bone. The fingers at the first phalangeal joints are palmar-inflexed at a right angle to the first phalanges, and motion is greatly restricted by partial ankylosis.

All the reflexes of the feet and legs, deep and superficial, are absent, as are the cremasteric and abdominal reflexes. The deep reflexes of the arms are exaggerated, except over the extensor region of the left forearm.

There is no failure of any of the affected muscles to respond to the faradic current, nor are there any reactions of degeneration, although the muscles of the legs and left forearm are atrophied to an extreme degree. The muscular wasting seems to be of the kind known as arthritic muscular atrophy.

All sensory phenomena and the special senses are normal.

To recapitulate, the principal points in this long history in the order in which they became manifest are:

1. Pain in the left hip and thigh, with rigidity of the adductor muscles of the thigh, from the fall of 1890 to the spring of 1891.

2. Pain in the right hip and lower portion of the spine with rigidity of the adductor muscles of the leg of the same side, from March to May, 1891.

3. Pain with swelling in the knee- and ankle-joints, followed by partial disorganization of the joints early in the year 1893.

4. Great pain and tenderness with some swelling in the upper dorsal and throughout the entire cervical region of the spine, early in 1895. The temporo-mandibular joints were affected at the same time, and subsequently became ankylosed.

5. Intense pain with great swelling in the left wrist, hand, and finger-joints, followed by great disorganization of the joints, fall of 1896. A little later pain developed in the left elbow.

You observe that about the only joints that have escaped are the right elbow, wrist, hand, and finger. For more than a year the patient remained in about the same condition, as described in the examination of October, 1898.

To-day the spine is rigid, evidently ankylosed from one end to the other, with forward arching and rotation to the left of the upper portion.

There are two points to which I wish especially to direct your attention. One is that the disease began centrally,—that is, in the large joints of the hips and pelvis,—and extended first up the spine,

and afterwards peripherally, finally involving nearly all the small and large joints of the extremities. The other, the absence of any evidence of organic nervous trouble.

I shall not tarry to discuss the differential diagnosis between this and other joint affections. I wish to bring two other patients before you.

In most of the text-books in which arthritis deformans is described two types are spoken of; one, the central, in which the hip, vertebral, and shoulder-joints are affected; the other the peripheral, in which the joints of the extremities are first affected. In neither type are the smallest joints thought, as a rule, to be affected.

During the last twenty years, but more especially during the last decade, several cases of rigidity of spine have been described. Three excellent articles, written by three distinguished neurologists, have recently appeared.[1]

One type to which attention was apparently first called by Professor von Bechterew seems to be a condition of chronic progressive rigidity of the spine attended by nerve-root symptoms, pains, anæsthesia, hyperæsthesia, paræsthesia, etc.

The second type has been prominently brought forward by Strümpell and Marie. In this there is chronic progressive rigidity of the spine, beginning in the hip, extending upward, involving the shoulder-joints to a slight extent, but unattended by any nerve-root symptoms.

It will be observed that the case, the history of which I have read to you, does not correspond to either of these types.

But let me proceed with the exhibition of other cases before attempting to draw conclusions.

Case II.—Michael F., fifty-nine years of age, born in Ireland, white, single, laborer by occupation, a resident of Colorado for nine years, was admitted into the Arapahoe County Hospital about three years ago.

Family History.—Father died of some fever, mother of consumption. One brother from paralysis. One of his father's cousins was affected in very much the same way as the patient.

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[1] "Rigidity of the Spine," Philip Zenner, Journal of Mental and Nervous Diseases, October, 1899; Dana, Med. News, November 25, 1899; Sachs, short abstract, ibid., published in full in Journal of Mental and Nervous Diseases, January, 1900.

Personal History.—In childhood patient had whooping-cough and small-pox, and was subject to sore throat attended by fever, probably tonsillitis, each year from his twelfth to nineteenth year. When thirty-five he contracted malaria, and suffered from it for eighteen months. Seven years ago he had la grippe, which was followed by a cough that lasted some years.

He denies having had syphilis or gonorrhœa. He has been a steady drinker.

The present trouble began in the fall of 1893, during convalescence from la grippe. The patient was seized with sudden, sharp, shooting pain in the right shoulder-joint, extending the entire length of the arm. The right shoulder-, elbow-, and wrist-joints became swollen and tender and the skin over them red. Soon the joints of the fingers of the right hand became involved. Two months later all the joints of the left arm and hand became similarly affected. About two months after the involvement of the joints of the left arm both knee- and ankle-joints became acutely inflamed and swollen.

In 1895 the cervical portion of the spine became stiff and painful. It was impossible to turn the head to the right or to raise it on a line with the trunk. About this time there was pain in the upper cervical region, in the head, and in the ears. Hearing in the left ear was almost completely abolished.

About three years ago both hip-joints became stiff and painful, but not to the same degree as the other affected joints. Soon after the invasion of the hip-joints the whole spine became rigid, and the patient was unable to sit up unless supported by pillows.

Examination, December 3, 1899.—The ankle, knee, hip, and vertebral articulations are completely ankylosed, so that the body and legs move as one piece. The shoulder-joints are partially ankylosed. The elbow-joints retain some freedom of motion. The wrist-joints are partially ankylosed and considerably disorganized. Muscular wasting is pronounced. There are no sensory disturbances.

This patient has a history of acute rheumatism. I bring him before you to illustrate a condition occasionally encountered, which, beginning, apparently, as simple acute inflammatory rheumatism, leads to chronic rigidity of the spine and presents symptoms very much like those of rheumatoid arthritis. I forgot to state that the adductor muscles of the legs are rigid.

CASE III.—Ellen L., colored, thirty-eight years of age, married, housemaid, was admitted into the Arapahoe County Hospital nearly three years ago.

Family History.—Mother died of consumption. One uncle had spinal trouble. Two sisters dead, but cause of death unknown. There is no history of cancer in the family.

Personal history before present illness is uninteresting. She denies syphilis, gonorrhœa, or alcoholism. About four years ago she began to suffer from pain in the lower portion of the back. It was usually dull in character, but was attended by periods of acute exacerbation. The pain was especially severe when an attempt was made to move the lower portion of the spine. At times it extended around the abdomen and down the thighs. The pain when acute never lasted long. The patient thinks that she has not been free at any time since her present trouble began, from a dull, heavy pain, described as an ache, in the lower portion of the back. After she had suffered a year from the spinal pain she noticed that the lumbar portion of the spine was being thrown forward, and her shoulders and hips backward. It soon became very difficult for her to sit on a chair.

Examination, January, 1897.—The patient is unable to walk or even to stand without assistance. There is no evidence of ataxia. The deep and superficial reflexes of the feet and legs are nearly normal. The abdominal reflexes are absent. The deep reflexes of the arms are normal. No areas of anæsthesia or hyperæsthesia are found. The special senses are in a normal condition. The muscles of the arms and legs are strong. All the joints of the legs, except those of the hips, are free from evidence of disease. There is no pain in the hips or sacro-iliac joints. There is slight rigidity of the adductor muscles of the thighs which restricts motion but little. There is a sharp curve in the lumbar region of the spine, the convexity looking forward,—a condition of lordosis. The muscles of the back, especially those of the lumbar region, are board-like to the touch. The abdominal muscles also are harder than normal.

Drs. Rogers and Parkhill saw the patient in consultation with me, and on careful examination they felt confident in excluding hip-joint disease. Under ether it was found that the rigidity and hardness of the lumbar muscles were nearly as great as before the administration of the anæsthetic.

The patient was repeatedly examined for areas of anæsthesia or hyperæsthesia, but none was found. I felt no hesitation in excluding a spinal growth. The only symptoms complained of were pain in the lower portion of back and hips, pains radiating around the abdomen, occasional stiffness of the back, and slight restriction of motion at the hips.

Potassium iodide was given in increasing doses until ninety grains were taken daily. During the first three months of her stay in the hospital there was considerable steady improvement. After about a year's residence in the hospital, it was noticed that the hip-joints were becoming more affected, and that movements of these articulations were becoming very limited. The legs, especially the right one, became strongly adducted.

Examination, December 3, 1899.—While either sitting or lying the left heel is raised two inches above its fellow. The right leg is rotated inward and adducted, so that the knee strikes the posterior portion of the left leg. The right leg can be straightened at the knee, but this increases the internal rotation of the leg to such an extent as to cause the anterior portion of the knee-cap to point towards the internal surface of the left leg. All movements at the right ankle-joint are free; no swelling in the right ankle and foot. The left leg can be extended and flexed at the knee, but in doing this internal rotation of the thigh is pronounced, but not so much so as the right. There is no affection of any joint of either leg below the hip-joint. When the patient is on her back the left knee lies over the right, and the latter, on account of the muscular rigidity, cannot be brought in front of the left. The adductor muscles are so firmly contracted that the knees cannot be separated. Ankylosis is complete at the right hip, incomplete at the left. The left thigh can be moved inward and forward slightly. The muscles of both thighs, especially the adductors, are hard and board-like. Figs. 3 and 4 represent the deformity of the spine better than it can be described.

The spinal curvature is greatest in the upper lumbar region. The muscles of the lumbar region are still hard and board-like. No deformity is present in the cervical or in the upper two-thirds of the dorsal region. There is no tenderness over the spine, but severe pain is complained of in each hip, in the lumbar and lower dorsal regions, in front of the lower portion of the chest and over

the abdomen. There is no trouble in any of the joints of the arms. All forms of sensation are normal, and the special senses are unimpaired. There have never been shooting pains in any portion of the body, but what pain there was has been dull and boring in character.

The trouble seems to be limited to the lumbar region of the spine and to the hips. The spinal pains antedated the hip trouble by nearly a year. The rigidity of the spine, I believe to be due to the rigidity of the lumbar muscles. It is doubtful whether there is any bone disease. The condition of the muscles might be explained by nerve-root irritation, due possibly to leptomeningitis or pachymeningitis. Against the view of nerve-root irritation is the absence of areas of anæsthesia or hyperæsthesia.

I have brought these cases before you to illustrate the strange anomalies that disease may present. Not one of them exemplifies the Strümpell-Marie type, or that described by von Bechterew. Case III. in its deformity is just the opposite of the type to which attention has been called by von Bechterew, yet I am inclined to believe that in its pathology it is somewhat similar. In other words, it seems to me that the deformity is probably due to muscular rigidity, and the latter to chronic changes in the spinal meninges, producing nerve-root symptoms. The latter were evidently much more pronounced before the patient was admitted to this hospital.

Case I. began like the type described by Strümpell and Marie, but it has gone further than the cases described by these writers, and has developed symptoms typical of the peripheral form of ordinary arthritis deformans. It presents, moreover, some symptoms more commonly seen in chronic rheumatism.

Case II. began as one of acute rheumatism, and now presents symptoms common to the Strümpell-Marie type of spinal rigidity and to arthritis deformans.

It seems to me that we are justified in concluding that there is a close relationship between all these cases of spinal rigidity, due to joint-involvement of rheumatic origin, and that any special type of spinal rigidity is only a sub-type of a general group.

The more I study the joint affections of chronic rheumatism the more fully am I convinced that they have a neuropathic origin.

DEGENERACY.

CLINICAL LECTURE DELIVERED AT THE MASSACHUSETTS GENERAL HOSPITAL.

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Gentlemen,—I wish to call your attention to-day to the subject of degeneracy, with a view of emphasizing its importance in the diagnosis of nervous conditions, particularly hysteria, neurasthenia, and like states.

The first case is one which has been referred to us from the surgical department, and in which no organic cause for the limp could be found. The patient is a young man of good height, rather delicately built, and of not rugged appearance. He limps, favoring the left hip. He states that twelve months ago he fell down a flight of twelve steps, but did not suppose he was seriously injured. Afterwards, however, he noticed a gradually increasing lameness in the hip. Pain was present one week after the accident, and increased. One month later he took up crutches and used them for two months; he was then confined to bed for five months with pain and stiffness. This condition has persisted until to-day, but it is improving. On physical examination we find the movements of the hip perfect, the muscles of the buttock and thigh symmetrical and not wasted; all movements of the hip, however, appear to cause pain. Further examination shows that touching the skin over the hip or thigh is also followed by signs of distress. Tapping the knee produces marked evidence of discomfort, but this is provoked by so light a touch as to preclude its being due to pressure upon the hip-joint. Similar but more pronounced reaction follows testing the knee-jerk, which causes the patient to jump in a marked manner. Testing the knee-jerk on the other side gives a like response. The patient is highly sensitive: he jumps when I approach his face to test for hemianæsthesia. There is no defect of motion or impairment of sensation.

The history of this case, together with the physical examina-

tion, points to so-called "hysterical hip." Such a condition in a normally constituted young man is unusual, and we are led to search for an underlying cause. His history shows that he was never robust, and that twelve years ago he had an illness which he states was called congestion of the brain and kidneys, and he presents the scar of an unsuccessful operation over the sacral region attempted for his relief. Just what this operation was we have no means of knowing. The history in connection with his present condition is strongly suggestive of an attack of nervous prostration or some allied trouble.

On inspection we find a marked difference in the size of the ears, the left ear being a quarter of an inch longer than the right one. The conformation of these organs is normal. The palate is high and narrow, and has a marked torus palatinus, or longitudinal ridge, in the median line. To his mental characteristics we already have a clue in the highly sensitive manner in which he conducts himself under examination. These physical stigmata alone are not numerous enough to be more than suggestive, but the difference in the size of the ears is sufficiently marked to aid us materially. Physically, we find a moderate lack of symmetry; mentally, the deficiency is more pronounced. Such signs are known as the stigmata of degeneracy, by which is meant mere deviation from the normal type, mental or physical. One or two stigmata are present in practically all individuals. This is to be expected when we remember the various depressing influences, physical and mental, under which some of the progenitors in every line have labored. Constitutional disease, privation, overwork, various forms of physical and mental stress, naturally affect the progeny and impair, to a greater or less extent, the ideal symmetry of mind and body. One or two stigmata of degeneracy, so-called, are therefore to be expected in every individual; but when in a given patient they are found in large number, or in a marked degree, their significance becomes considerable, inasmuch as we generally find that the possessors of many or marked stigmata of degeneration are unable to meet the ordinary demands of life. They may be said to labor under a handicap which must be taken into consideration in determining their physical or mental condition, and in estimating the degree of responsibility and endurance to be expected of them.

If such patients present themselves with hysteria, neurasthenia, or hypochondria, the prognosis as regards recovery is much more serious than in individuals of robust build whose condition has been reduced, perhaps, by a like exciting cause.

Before taking up the subject in general I should like to call your attention briefly to another case, more marked physically, which has been sent to us from the medical room. This young woman has been treated for many months and by various physicians for abdominal pains. Physical examination has revealed nothing beyond an infantile uterus, deemed to be in a position of anteflexion by some examiners, by others to be in a normal position. The pain is seated principally in the right iliac region, though the whole abdomen appears sensitive to pressure. Dr. Minot believes the trouble to be mental rather than physical. He has called my attention to the fact that the pain produced by pinching up a fold of skin over the abdomen does not differ from that following pressure upon the abdominal wall. Physical examination of the abdomen is absolutely negative.

In this case we find more numerous stigmata than in the young man. You note the marked asymmetry of her face, the unevenly set eyes, the narrow right palpebral fissure, the one-sided chin. Prognathism is marked, the lower teeth projecting far beyond the upper; there is torus palatinus, the helix of the right ear is crumpled, and the lobes are wanting. The presence of these signs strongly inclines us to favor Dr. Minot's diagnosis; at the same time they tend to show that the hysterical trouble is not a temporary one, but that lack of mental balance is a part of her general defective organization. The prognosis in such a case is that, though the patient may recover from this particular attack, she is likely at any time to give way under circumstances which would not cause an ordinary individual to break down.

Perhaps an appropriate text for this lecture would be the remark of the Quaker lady to her friend: "It seems to me that every one is a little queer save me and thee, and sometimes I think *thee* is a little queer." The application of the text is that we all have signs of degeneracy. It was only the other day that I heard a physician say, "Astigmatism a sign of degeneracy? How can that be,—almost every one has astigmatism?" This remark shows the prevailing misconception of the term degeneracy; and if a scien-

tific man holds such crude views on the subject, what wonder that the laity look askance at the diagnosis.

Unfortunately, too, the popular mind has conceived the idea that murderers, perverts, and chronic criminals are degenerates, and jumps not unnaturally to the conclusion that a sign of degeneracy places its possessor in this class.

This is much as if the statement that so-and-so took a glass of claret at dinner or was seen sucking cider through a straw, was equivalent to calling him a drunkard, or to classing his case under alcoholism. The question is not, "Has so-and-so stigmata of degeneracy?" for he must have one or more in common with all humanity; but rather, "Are the signs of degeneracy he presents so numerous, so marked, or so serious, as to warrant classing him with the *degenerates?*" For there is a long step between having a few signs of *degeneracy* and being a *degenerate.* Before the latter term is applicable, the physical defect should suffice materially to impair health and the capacity for fulfilling the ordinary duties and enjoying the legitimate pleasures of life; or the mental stigmata should be sufficiently pronounced to prevent the proper recording of impressions, and of planning and carrying out logical lines of conduct based upon them, with due respect to the claims and rights of others. If, on the other hand, an individual has merely a few trivial physical stigmata, such as an adherent lobule or a slight facial asymmetry, or if, again, he is merely somewhat eccentric or possesses talents developed at the expense of others, he has only traces of degeneracy which have no special bearing on his life.

What is the practical value of this knowledge? It influences the study of heredity, development, and care of the human mind and body, and no one whose work has to do with such study and such care can afford entirely to ignore it. A misplaced sentimentality seems to hinder such observation of the human frame as is deemed requisite to the knowledge of other animals. A child early learns to recognize suspicious signs in the physiognomy of the domestic animals with which he comes in contact, but his attention is never called to the physical signs in the human being which may throw light on his mental characteristics. It looks at present, however, as if the laity bid fair to know quite as much of the matter as the physician at large. This is a great mistake, for while the benefit

of this knowledge to the public may be still problematical, its value to the practitioner is undoubted.

The physician who deems it impractical to interest himself in the pursuits, pleasures, and social relations of his patients, and the management, the instruction, and the development of their children, will find himself at a disadvantage in practical matters of diagnosis and treatment if he knows nothing of the physical and mental manifestations of degeneracy.

Such a physician may be consulted, for example, by a delicate young woman with headaches, frontal, temporal, and occipital, such as ordinarily result from eye-strain,—she has an oblique astigmatism or muscle insufficiency. He corrects the error, predicting cure; but no relief appears. He then finds that she has a deviated septum or swollen turbinates, sends her to the nasal specialist for six months' unavailing treatment. He then finds a uterine misplacement, which he treats with like result. What is the diagnosis? Constitutional headaches of degeneracy,—a diagnosis the probability of which could have been established at the first visit from a little knowledge of the stigmata and a few brief inquiries into the patient's parentage and ancestry. The astigmatism, deviated septum, and uterine disorder were only some of the physical stigmata, not the underlying cause of the symptoms.

Again, he may have had a few uncomfortable experiences perhaps with traumatic hysteria or neurasthenia, and decides not to be again deceived. In the next such case he sees suffering from a slight strain or fright, he confidently predicts speedy recovery after the termination of agitation, not noting the asymmetrical face, the prognathism, the high, narrow palate, the malformed ears, the fussy antagonism or complacent egotism, the unreasonable antipathies of the degenerate, and not knowing that perhaps the patient's sister became a chronic invalid after losing a favorite child or that her mother always sat on an air-cushion and that her father was an epileptic.

What is degeneracy? Not a popular fad or passing whim,—not a recent invention. Morel as early as 1857 published extended observations on the subject, calling attention to the bearing of heredity on the various types of mental disease, and showing that syphilis, consumption, privation, and overwork in the ancestor left their imprint on the body and mind of the individual, and that

morbid deviations from the normal type so produced tended to perpetuate themselves, and if extensive or numerous in a family deserved a special place in the nomenclature; such deviations he termed degenerate. Since that time the subject has been amplified, and a long list of stigmata accumulated, some trivial, some of grave import, some rare, and some common to almost the entire civilized community. With this list we shall concern ourselves shortly.

It is unfortunate that this term was chosen, for it implies an unmerited blame. It is certainly no cause for reproach if, in a long line of ancestry, overwork and worry, privation and consumption, or a hundred other drawbacks, have prevented the transmission of perfect physical and mental symmetry. He who regards the subject in this light, and who yet aspires to have no signs of degeneracy, reveals an exalted egotism which is in itself suggestive. It shocks no patient to be told he is high-strung; that he is unusually sensitized; that he has a neuropathic disposition or a New England conscience; and it would be well if we could adopt some equally pleasant word to use in the presence of the patient to signify the physical stigmata of degeneration. The term "constitutional" may sometimes be used to advantage,—*e.g.*, instead of degenerate headaches, we may say constitutional headaches, instead of mental stigmata we may speak of a high-strung, delicately organized temperament, etc. However unfortunate the choice of name, it has come to stay; and it is as likely that the corner grocer will sell by the metric system as that the public (scientific or otherwise) will accept a more euphonious term. The only alternative is so to accustom ourselves to the word that it ceases to offend.

The subject has been brought forward by Lombroso and by Nordau in recent times in a manner calculated to reach the public, through its interest in criminology and other matters appealing actively to the popular imagination,—I might perhaps say to that morbid craving for sensationalism and fad which is itself a sign of degeneracy according to one of the authors mentioned.

Nordau, before discussing the physical and mental stigmata which interest us as physicians, calls attention to what he names the *fin-de-siècle* frame of mind which he says dominates whole peoples, more especially the upper classes. The vagaries of this attitude of mind are better illustrated than defined; and he cites

as an example of it a wedding in a gas-factory followed by a bridal trip in a balloon. This he calls a *fin-de-siècle* wedding.

He shows how this morbid craving for sensationalism dominates modern music, drama, and literature, comparing the tendency to the morbid search for new pleasures of the hoary voluptuary who has long since exhausted the legitimate channels.

We need only take his musical illustration to grasp the idea,—the musical public is no longer satisfied, he says, with the logical development of a theme to its legitimate conclusion, but craves sudden changes of pitch and key, sharp pauses, odd sounding and varied instruments proceeding independently and without method beyond weird and mystical, or abrupt and startling, effects, carried to no legitimate termination save dissolution into mystical obscurity.

The question which concerns us as physicians, is, What are the mental and physical stigmata of degeneracy, and in what do they concern the practice of medicine?

The practical bearing of this subject is a broad one, and has, perhaps, more to do with diagnosis and prognosis than with treatment; though a proper understanding of it may modify treatment,—*e.g.*, misdirected efforts may be replaced by reasonable methods.

The chief advantage of this study lies in acquainting the physician with one type of individual with which he has to deal rather than in showing him new methods of treatment. Unfortunately, in many instances the only thing he learns is that he is fighting a deep-rooted tendency, while he fancies he is fighting only a symptom,—that he is struggling against an inherent characteristic when combating what appears to be merely the result of a temporary physical or mental shock.

Diagnosis and prognosis, then, are placed on a higher plane if degeneracy is properly understood and recognized; and the inevitable result must be an improvement, though perhaps a somewhat indirect one, in treatment.

Again, the practitioner is often asked, and asks himself, What is the *cause* of hysteria, epilepsy, or idiocy? The laity is prone to assign these conditions to a fall or a blow, to a disappointment, or to a mental or physical shock, while the physician gropes for a pathological lesion. When one has had extended opportunity to

study this class of disease he cannot fail to be impressed by the frequency with which he finds neurasthenia or hysteria, or at least morbid sensitiveness and self-analysis on the part of the parents; and then his conception of the underlying trouble becomes more clear.

Again, the practitioner is often consulted regarding the management of unruly children, a field in which his advice will become much more valuable if he has his eyes open to the importance of degeneracy.

Stigmata, physical and mental, are evidence of deviation from the normal type.

Peterson characterizes possessors of marked mental stigmata as "borderland dwellers," if nothing worse. Some faculties are under-developed, others exaggerated; in such persons the moral sense may be utterly wanting, while hypersensitiveness in other directions is marked.

The paranoiac will commit crimes and accuse innocent persons of crime with the calmest complacency, and cannot appreciate why others take offence; this type of moral obliquity represents a high degree of degeneracy.

Its most marked mental characteristics are, according to Nordau, intense egotism, impulsiveness, and emotionality. The egotism may show itself in early life by abnormal sensitiveness to criticism and slight, and even to delusions of persecution, resulting from the feeling on the part of the sufferer that the conversation of others, even of strangers, always relates to himself; later, the very fact that he is singled out for persecution may lead to the delusion that he is of great importance, and hypochondriacal melancholy is replaced by calm self-satisfaction,—this is the classical type of the paranoiac. Impulsiveness and emotionality lead to hysterical manifestations, and to morbid dislikes, as to persons, animals, odors, or objects. The mere odor or sight of the object of loathing may excite in such a person a frenzy or a convulsion.

This hypersensibility is more than likely to be offset by indifference in other directions, such as to the rights, convenience, or tastes of others,—a by no means happy combination in a fireside companion. Such people are the reverse of practical; and while prone to revery, analysis, and criticism, lack the practical initiative

to do what comes to hand, or to carry out the lines dictated by their perhaps elaborate, but vague and idealized, prospectus. Such persons also are often tormented by doubts from self-analysis,—may arise from bed and turn on the gas to see if they had turned it off; unlock the door to see if they had locked it. I once had a patient who was so doubtful whether he had buttoned his waistcoat that he would hold with one hand the button he had secured while proceeding with the other hand to fasten the next button. At a later stage he doubted even his power of feeling, and would gaze fixedly at the button as well as hold it in place. He would finally become so excited with the warmth of his arguments on such simple questions that he became incapable of any continuous action. It is needless to say that the patient was well over the boundaries of the borderland.

Unequal development of mental traits is an evidence of degeneracy; from this class come many geniuses, and mathematical or musical freaks; still we should not adopt the view that *all* geniuses are degenerates, or that *all* musicians or talented individuals are cranks,—this inference is drawn by the unthinking, and by those who appreciate only crude colors and bald ideas.

In answer to the question, Why let the public into the mysteries of this subject? Nordau says that instruction therein may lead to changing the popular ideal. The girl in her formative period who deems it creditable to be highly sensitized and emotional is in far greater danger of becoming so than one who is taught to regard such traits as morbid and degenerate, and that the restraint of emotionality within certain limits is desirable.

We have ample opportunity to impress such truths upon our patients, and we may here and there succeed in reclaiming an embryo hysteric or paranoiac.

Again, we should impress upon the poorly balanced and doubting individual the importance of prompt decision after giving a question due consideration, and lead him to realize that an occasional mistake is preferable to habitual indecision. Unfortunately, such morbid tendencies are, as a rule, too deeply rooted to disappear at command; but much may be done, by proper instruction, especially if we begin early in life; the establishment of a correct ideal is in itself a step in the right direction.

We may perhaps check the tendency to morbid sensitiveness or

irascibility in the child or young adult by leading him to recognize his comparative importance in the world, and to put himself in the place of those from whom he receives real or fancied slights, instead of taking offence and either flying into a passion or withdrawing to brood in solitude.

In other words, we may be able to point out to each individual his morbid tendencies, and indicate the means by which he may lessen, if not eradicate, them. We may also help parents and teachers by showing them the natural deficiencies of the children under their charge. Such knowledge is to them of paramount importance in deciding what allowances to make, what punishments to inflict, what rewards to offer, and what censure to avoid.

Such observations and such efforts are by no means new; they antedate by centuries the invention of the term degeneracy. The work of Morel, Nordau, Lombroso, and Peterson has served, however, to classify our facts and to crystallize our knowledge.

We cannot eradicate the physical stigmata, but recognition of them will aid us greatly in estimating the mental warp towards the straightening of which our efforts should be directed.

Such considerations have led Nordau to advocate placing this knowledge frankly and freely in the hands of the public, in the hope that while it may be sometimes misapplied, the ultimate result will be a gain.

Knowledge and peace of mind have at no time been synonymous, and if an occasional heartburn is offset by an honest effort to correct such uncomfortable traits as morbid sensitiveness and uncontrollable aversions, the sum total may, if Nordau's plan is followed, after all, show a balance to the credit side of the personal ledger; and the individual who cannot change his physical nature may perhaps sometimes be enabled to replace the calm of ignorance by the satisfaction of laudable endeavor, and take comfort in the reflection that he who governs himself is greater than he that taketh a city.

We come now to the enumeration of the physical stigmata of degeneracy. The following list (taken principally from Peterson and Dana), though not exhaustive, covers all practical points likely to come under our observation. This list also recapitulates the mental stigmata. The signs are classed for convenience of reference as anatomical, physiological, and mental.

Anatomical Stigmata.—Cranial anomalies, *e.g.,*

Asymmetry of cranium.

Microcephalus.

Peculiar shape of skull, trigonal, scaphocephalic (keel-shaped), plagiocephalic (one-sided), platycephalic (flat-shaped), oxycephalic (steeple-shaped), leptocephalic (narrow).

Facial asymmetry, and excessive prognathism or retrognathism, excessively prominent forehead, especially in the female.

Large jaws.

Deformities of the palate and uvula, including high, narrow arch and the torus palatinus, hip-roof, flat-roof, horse-shoe roof.

Anomalies of the eyes: unevenly set; narrow palpebral fissure, muscular insufficiency, excessive astigmatism, nystagmus, myopia, hypermetropia, coloboma, different colored irides, albinism.

Anomalies of the ears; misplaced, irregular shapes, asymmetry, adherent or lobeless ears, markedly conchoidal ears; too flat, too broad, too prominent, too long ears; prominent antehelix, flattening of lobes, broad helix.

Anomalies of the limbs, genital organs, and body generally; phocomelus, amelus, symmelus (limbs shortened, wanting or grown together); same of fingers; arms too long; gigantism; dwarfism; femininism in man, and masculinity in female.

Anomalies of the skin: excessive hairiness in the female, or absence of hair in the male.

Anomalies of the teeth: irregular, double; striated; absence of enamel; rudimentary or absent lateral incisors.

Physiological Stigmata.—Tardiness in learning to walk, deaf-mutism, migraine, neuralgia, sexual irritability, impotence, sterility, tremor, tics, nystagmus, and hereditary defects in the muscular system leading to atrophies. Excessive or defective sensibility of the cutaneous and special senses, defects in speech, stammering, stuttering, perversions of the sexual and other instincts are to be classed here, as well as incontinence of urine, retarded pubescence, and pavor nocturnus. Diminished resistance to nervous and emotional strain is a most frequent physiological mark of

degeneracy, as is also lessened resistance to physical strain and injury.

Mental Stigmata.—Insanity, epilepsy, neurasthenia, hysteria, idiocy, periodical insanity, paranoia in milder form, erratic tendencies, emotionalism, egotism, lack of mental balance.

I hope that this rather sketchy *résumé* of the subject will serve to impress the fact that whatever view may be taken regarding the advisability of placing the subject in the hands of the public, the physician who comes in contact with hysteria, neurasthenia, epilepsy, idiocy, or insanity must have at least some understanding of degeneracy in order to estimate the symptoms correctly, to cast successful prognoses, and to devise measures for treatment.

Surgery

GASTROSTOMY BY KADER'S METHOD; CHOLECYSTECTOMY.

SURGICAL CLINIC HELD AT THE GERMAN HOSPITAL, NEW YORK CITY.

BY WILLY MEYER, M.D.,

Attending Surgeon to the German, Skin and Cancer, and Post-Graduate Hospitals, New York City.

GENTLEMEN,—This patient, forty-two years of age, has had difficulty in deglutition for the past seven months. Lately he has had the same difficulty in swallowing liquid as he first had in swallowing solid food, and during the past three days not a drop of water has passed his œsophagus; anything he attempts to swallow is immediately rejected. He has, of course, lost considerably in weight. His breath is foul and his expectoration very offensive. He says he feels, when swallowing, an obstruction behind the upper portion of the trachea. There is undoubtedly a stricture of the œsophagus at this point, due to malignant disease, and the growth, I believe, is ulcerating.

Some surgeons have treated cancer of the upper portion of the œsophagus in a radical way by resection of the œsophagus, closing the gap by a following plastic operation. Czerny was among the first to do this. But this patient's general health will not permit such an operation now. I will therefore do a gastrostomy. If sufficient improvement follows, one might then think of a resection of the œsophagus, although I fear that in this case the neoplasm is situated too low to be radically dealt with. The introduction of the œsophageal tube to locate exactly the seat of the tumor has purposely been omitted in this instance on account of the disastrous consequences that so often result from its use. To establish the diagnosis of carcinoma of the œsophagus is generally not

difficult. If the patient has trouble in swallowing without having previously burned his œsophagus with acids, caustic, lye, etc., if he progressively loses weight and presents other cachectic symptoms, and if, furthermore, the presence of an intrathoracic tumor pressing upon the œsophagus cannot be made out, the diagnosis of carcinoma is clear.

Of the many operative procedures which are now at our disposal when establishing a gastric fistula, I prefer Kader's method. It is done as follows: An incision three or four inches long, penetrating skin and fascia, is made parallel with the linea alba, at about one and a half or two fingers' width from the same. After blunt division of the left rectus—undoubtedly the preferable road—the abdomen is entered, the stomach pulled forward and primarily opened by a very small incision. If the stomach is movable, the presenting fold is, of course, first well drawn in front of the abdominal wall, in order to do the operation as much as possible extraperitoneally, the surrounding intestines having been protected with aseptic gauze. A drainage-tube the size of a lead-pencil is then introduced into the stomach for about one inch and a half, and fastened to the gastric wall by a catgut suture. Then a fold of the stomach wall (sero-muscular layers) about half an inch wide is raised on either side of the tube, and the two are drawn together by sutures, two above and two below the tube (so-called *deep occlusion sutures*). By tying these sutures,—the deep occlusion sutures,—which, as mentioned, include the serosa and the underlying muscularis, two longitudinal folds are produced which turn the wall of the stomach inward in the immediate neighborhood of the tube and embrace the latter as in a narrow funnel. Then a second fold is stitched on top of the first in the same manner (*superficial occlusion sutures*), thus deepening the funnel. The field of operation is brought outside of the peritoneum by inserting sutures on either side of the wound, passing through the transversalis fascia and peritoneum, and including the stomach. In order to hold the stomach firmly during this latter manipulation, the outer threads of the superficial occlusion sutures should be left long, to serve as convenient tractors. The tube is thus brought within a funnel, which is everywhere lined by the serosa, whose opposing surfaces soon become adherent. The wound in the abdominal wall is then sutured, layer by layer, and primary union

takes place. Patients are usually up the second day after the operation, and may be discharged in a short time. It is important for them to get about as soon as possible. The advantage of this operation is that the patient can be fed at once through a comparatively large-sized tube, and leakage is impossible.

The other operation, of more recent date, Marwedel's, I have done five times. It consists in opening the peritoneal cavity by Fenger's oblique incision and stitching the parietal peritoneum to the skin. A fold of the anterior wall of the stomach is then drawn out and in the usual manner sewn into the abdominal wound with a continuous catgut suture. The wall of the stomach is now split in a direction parallel with the external wound for a distance of from four to five centimetres, the incision being carried through only the serous and muscular coats, which are dissected loose from the mucosa for a short distance on each side. At the lower angle of the gastric wound an opening is made through the mucosa into the cavity of the stomach, and through this a small rubber tube is introduced and fastened to the mucous membrane with a catgut suture. The serous and muscular coats are then stitched together over the tube by means of interrupted or continuous sutures. The tube thus rests between the muscular and mucous layers of the gastric wall. This is an excellent operation, but the after-treatment is more difficult than in Kader's. If the tube is not very soft, and if it is left in place too long at first, the primary union of the gastric layers may yield. The result is a large, gaping wound in the stomach. The functional result in Marwedel's operation is all that could be desired; the fistula obtained is water-tight; its calibre is rather small at first, but this can be afterwards enlarged to No. 21 or 24 French gauge. The patient learns to feed himself by introducing a glass or silver tube, preferably of the shape of a female catheter, through the oblique fistula into the stomach. This he can do and remain perfectly dry. If, however, it is desirable to have the patient out of bed as soon as possible, Kader's operation should be preferred, although it may at first sight seem a little more troublesome to perform. Kader first published his operation in July, 1896. Ten days after its publication, July 21, 1896, having a suitable case on hand, I did this operation myself, with perfect success. When I showed the patient before the New York Surgical Society, he could, with a previously filled stomach, stoop down and

cough, the tube having been removed, and remain perfectly dry. The fistula proved to be absolutely water-tight. It was a most satisfactory result. I have tried all methods of gastrostomy so far devised, and much prefer the one I have just done,—Kader's.

It is a great mistake on the part of the general practitioner to send patients afflicted with œsophageal stenosis to the surgeon too late, at a time when their strength and their power of assimilation are so reduced that they cannot readily recuperate from the operation. As a rule, so soon as the patient shows a steady decrease in weight, the operation should be performed, provided, of course, the diagnosis has first been properly established.

The patient made a rapid recovery from the operation; was out of bed on the second day.

The next patient is a woman, forty-seven years of age. The case is an interesting one with regard to the diagnosis. Since last September she has from time to time presented symptoms resembling those attending the passage of gall-stones. She has had repeated attacks of acute, sharp pain radiating to the back and the right shoulder, which were accompanied by vomiting. These have recently been so severe as to necessitate the use of morphine. The patient states that at the time of her previous attacks the doctor had been able to make out in the region of the gall-bladder, just below the border of the ribs, a prominence which was painful to the touch. She has never been jaundiced. If the patient's trouble be due to gall-stones, she is at present in the interval. All clinical symptoms pathognomonic of gall-stones are absent except local pain in the region of the gall-bladder on deep pressure. The interesting point in the case is that the patient also has a movable kidney on the right side. In order to do the best for the patient, I shall make an exploratory incision. We can then see what is really the matter. In this case I do not propose to make the oblique incision parallel to the border of the ribs, which I often employ when operating for gall-stones, on account of its giving so much room for the intra-abdominal work. I shall carry the incision longitudinally through the right rectus muscle, bluntly dividing its fibres, so that if I do not find the condition I believe to be present the wound can be easily closed and will heal without producing a

weak spot in the abdominal wall. If all the patient's symptoms should be due to the movable kidney, a condition which I deem hardly possible, nephropexy can be performed after a few days.

An incision penetrating the right rectus muscle is made parallel to the median line and about an inch and a quarter away from it, commencing below the free border of the ribs, about corresponding to the end of the ninth right costal cartilage. The posterior sheath of the latter is divided and the abdomen opened. There are many adhesions in the region of the gall-bladder, which is surely the focus of the disease. The diagnosis of cholecystitis is correct. The gall-bladder is evidently distended with pus; its walls seem to be exceedingly thin. In spite of the presence of pus in such quantities the patient has had no rise of temperature, surely a very important clinical fact. The walls of the gall-bladder are so thin that by very gently separating the adhesions it ruptures and pus escapes. Around it I shall now pack gauze, to prevent infection of the general peritoneal cavity, and then remove the pus that remains with a trocar, afterwards incising the organ with the knife at the place of puncture. This gall-bladder is so diseased that it must be extirpated. For this purpose the cystic duct may be ligated by means of a double ligature, and the gall-bladder then separated from the liver; or, as I shall do in this instance, the gall-bladder may be separated first and the cystic duct then tied off. The liver and the gall-bladder are more adherent than is usually the case. The cystic duct can be distinctly felt and is distended by a large gall-stone. I shall first detach the gall-bladder and then try to push the stone back into it. The stripping of the gall-bladder from the liver will be effected by means of the actual cautery. Hemorrhage is thus controlled, or, if it nevertheless occurs, will soon yield to compression. In all cases of this kind the cystic common and hepatic ducts must be carefully palpated to determine whether impacted calculi are present. As you see, I succeeded in pushing the stone into the bladder, and have extracted it. There is only one, the cause of all the trouble. Of course, it will be necessary in this case to drain the former seat of the gall-bladder with strips of sterilized gauze. Only the lower two-thirds of the abdominal wound will be closed, preferably by layer sutures.

The patient made an uninterrupted recovery.

MODIFIED BARTON'S OPERATION FOR BONY ANKYLOSIS OF THE KNEE; A BRIEF REPORT OF FOUR CASES.

A CLINICAL LECTURE DELIVERED IN THE KENTUCKY SCHOOL OF MEDICINE HOSPITAL IN MAY, 1898.

BY WILLIAM L. RODMAN, A.M., M.D.,[1]
Of Philadelphia, Pennsylvania.

Gentlemen,—While the anæsthetic is being given to the patient I will briefly record three nearly similar cases of bony ankylosis of the knee-joint in which there was great deformity, and which were operated upon by a modification of Barton's method, with perfect results. It is surprising how frequently cases of this character are met with in practice. All cases operated upon occurred in exactly the same way,—viz., from a wound in the knee by a hatchet or axe, in three instances received while splitting wood. In each there was suppurative synovitis, followed by bony ankylosis with the leg in bad position. Two of the cases were operated upon in this clinic, the other in private practice.

After performing this operation, a wedge-shaped piece of bone having been removed, the limb should in all instances be brought into a very slightly flexed position, because a person cannot walk as well with a perfectly straight limb as with one that is slightly flexed. Treves and some other surgeons take the ground that the leg should be put in a position that is perfectly straight. I think this is not good teaching, for the reason stated.

Several operative procedures have been practised for the relief of bony ankylosis of the knee. First, a linear osteotomy may be done, the femur being cut just above the knee-joint and the limb extended, in this way correcting the deformity to a certain degree. The procedure is very simple, and consists in making an incision down to the bone, inserting an osteotome, which is entered longi-

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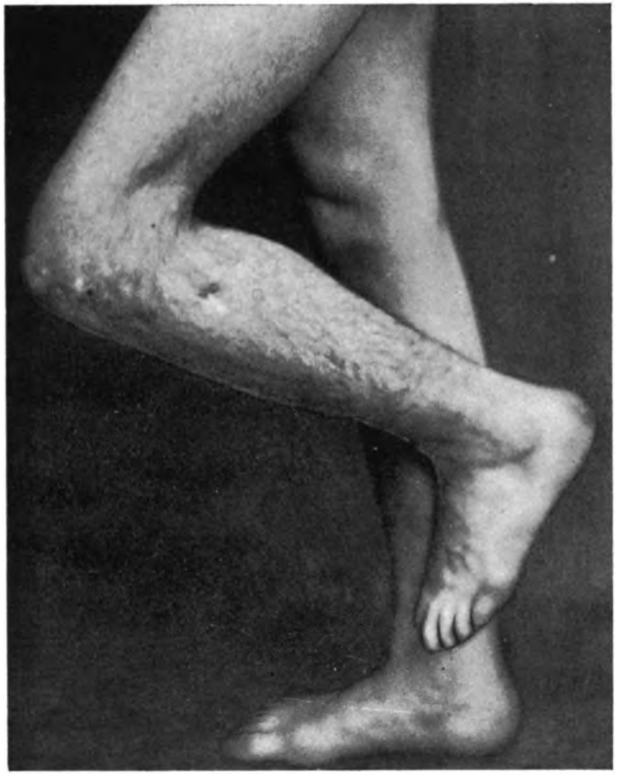
tudinally and then turned vertically, severing the bone just above the epiphyseal line. The deformity, however, is in most instances so great that it cannot be corrected by simple linear osteotomy, nor do I believe it would be advisable in such cases to make a double osteotomy of the lower end of the femur and upper end of the tibia.

The operation which appeals to me most is a cuneiform or wedge-shaped osteotomy, in which we expose the tissues so as to remove a wedge-shaped piece of bone, and in this way bring the leg into a condition of almost complete extension, and maintain it there by the application of a plaster-of-Paris bandage.

Another method of procedure is to resect the joint, removing part of the articular surfaces of the tibia and femur, at the same time removing also the patella. Whether a cuneiform osteotomy or a resection of the lower end of the femur and upper end of the tibia is practised, the patella should be removed. I have done this in all my operations of this kind, for I cannot see what possible good can come from leaving the patella, and there may be harm from it. When the leg is left stiff there is no use for the quadriceps muscle, the patella is more apt to interfere with union than to facilitate it, and especially in younger subjects it is liable to become the focus of tuberculous disease.

Case I.—My first operation of this kind was performed six or seven years ago upon a man aged twenty-three years. Fig. 1 shows the very marked deformity of the left leg before the operation and Fig. 2 the result. They also show several cicatrices which resulted from punctures made by a local physician for relief of a suppurative synovitis following an axe-wound of the knee-joint. I was told in January, 1898, that this man was at that time regarded as the best farm hand in Trimble County, Kentucky.

I removed a triangular portion from the lower end of the femur, but did not go quite through the bone, leaving the posterior shell, and then bent that when the leg was forced into proper position. The posterior shell of the femur was left because the deformity had existed many years, and I was afraid that if I sawed entirely through the femur some injury might be done to the popliteal vessels. I did what might be called an atypical Barton's operation. The incision in the soft parts was not made as he makes it, and the patella was removed at the time, which he did not do. The result was perfect.



FIGURES 1 and 2.—Wm. D., aged 22, Trimble Co., Kentucky. Bony ankylosis of many years' standing due to suppurative synovitis.

FIGURES 3 and 4.—Rora H., aged 12. Bony ankylosis of five years' standing.

Case II.—The second operation was upon a girl, twelve years of age, who was brought to me from Indiana four years ago. Five years ago she was struck on the left knee with a hatchet. She subsequently had a suppurative synovitis, which never discharged spontaneously and was lanced by the attending physician. The cicatrices were still present, one just opposite the joint, and one lower down, almost midway between the knee and the ankle. After satisfying myself that the ankylosis was bony and that a radical operation would be necessary, I sent her to this hospital and operated the following day in the presence of the class. I did not decide what operation to do until after cutting into the knee-joint. I had, however, thought that linear osteotomy was out of the question, as it would not correct the deformity. I did not care to make a cuneiform osteotomy of the anterior surface of the femur, because it might interfere with the epiphyses. I hoped to be able to chisel away the adhesions between the end of the femur and the tibia, without removing any bone; but after cutting into the joint by the ordinary incision, extending from condyle to condyle, I found that the patella was tightly adherent to the lower end of the femur, also slightly diseased, as evidenced by constant pain in the lower end of the femur and upper end of the tibia. The patella was removed. Not being able to bring the limb down into proper position by chiselling away the adhesions, I removed a small portion of the lower end of the femur and the upper end of the tibia. So little bone was removed that no shortening resulted.

The patient did uninterruptedly well, the case running a perfectly afebrile course. The wound was redressed to remove the drain, and no discharge was found,—the skin was not even reddened,—and I am satisfied that if I had let it remain healing would have taken place under one dressing. The result was perfect. Figs. 3 and 4 show the girl before and after the operation.

Case III.—The third patient was a man, aged twenty-seven years, whose deformity was not quite so great as in Cases I. and II. He was, however, practically a helpless cripple, and relief was demanded at the hands of the surgeon. An atypical Barton's operation was performed, and the result was just as good as in the other two cases. Unfortunately, I had no photographs taken of this patient.

Case IV. will be reported a little more in detail, as the patient is now being prepared for operation.

The patient, a boy, nineteen years of age, applied to me for re-

lief from a complete bony ankylosis of the left knee with great deformity. (See Fig. 5.) When he was seven years old, while using a hatchet, he accidentally cut into his knee-joint. A septic synovitis with profuse suppuration occurred, and he has ever since had as a result this complete bony ankylosis. Considerable shrinkage of the muscles of the thigh followed, but I think that the atrophy is due solely to lack of use. His deformity is so great as to attract attention wherever he goes, and calls for relief at the surgeon's hands. He would be better off with an artificial leg after amputation at the lower third of the thigh, which has been advised by two surgeons who saw the patient before he came to me.

I will do an operation like the one first described, though I think excision of the knee-joint might be necessary; in any event, one cannot state positively what should be done until the bones are exposed and the parts carefully examined. A linear incision will be made, just as in a typical resection of the knee-joint, extending from the inner to the outer condyle. Every precaution has been taken to make the parts thoroughly sterile before the operation and to maintain asepsis throughout.

There is one great danger in all these operations,—viz., the operator may be compelled to amputate the leg before the patient leaves the table, and he should decline to operate until permission to do this is obtained if it be found necessary. I had this consent from the parents and patients in all the cases reported, and I would never undertake an operation of this kind without such permission. With a leg ankylosed in a flexed position, and having remained in this state for several years, the vessels, which normally lie right under the posterior ligament of the knee-joint, may become so adherent to the bones that, if the operator undertakes to straighten the leg to put it in proper position, he may, in spite of every precaution, rupture the popliteal artery. Should such an accident occur, it would be necessary to amputate the leg at once, otherwise the patient would bleed to death.

An Esmarch bandage has, I see, been applied in this instance, but it is really unnecessary to use either an Esmarch or a tourniquet in these cases; it is expected that no large vessels will be cut, and the use of the elastic bandage occasions a somewhat free oozing after the operation, on account of the vasomotor paresis which it causes, and I believe that it is rather a disadvantage than otherwise.

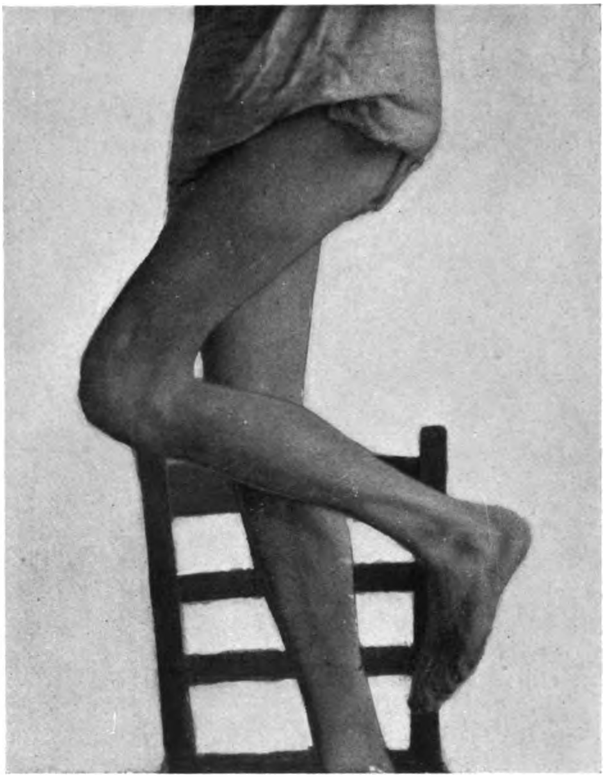


Fig. 5.—John C., aged 19. Bony ankylosis of twelve years' duration. Marked atrophy of muscles and limb.

In making an incision from the internal to the external condyle, the thing to avoid is wounding the internal saphenous vein, which passes over the bone at the inner extremity of the joint. The operator may be compelled to cut a number of the tendons, in order to enable him to bring the leg into proper position. I had to do that in each of the cases operated upon. There is usually great contraction of the tendons, which cannot well be overcome in any other way.

The patient being profoundly under the influence of chloroform, I find that there is absolutely no motion, confirming the diagnosis. The incision having been made as described, I remove the patella and cut rapidly down to the bone, removing a V-shaped or triangular wedge from the upper end of the tibia and the lower end of the femur. This is done with the Gigli wire saw, as you see, it being the first time I have used this instrument in such an operation.

It often becomes a nice question of mechanics in these cases to get out the proper amount of tissue, and repeated sections are sometimes necessary before the requisite quantity of bone is taken away. Several open tenotomies are required in this case. I sever the tendon of the biceps, and in doing so do not cut the perineal nerve, which is always a possibility. In cutting through the bone the posterior ligament, upon which rest the blood-vessels, should not be severed, because if suppuration occurs the pus burrows through into the popliteal space, which is something every operator desires to avoid. I removed a wedge-shaped portion of the bone and cut all the tendons which were contracted, but severed none of the vessels, nor was any of them ruptured by subsequent forced extension. The leg was then brought down into the proper position,—just short of complete extension.

The next question is, How shall the ends of the bones be held together? Shall pegs, silver wire, or anything else be used for this purpose? I have never resorted to measures of this kind, nor do I think them necessary. Union is obtained here just as in a case of fracture.

The Esmarch bandage having been removed, there is, you see, no hemorrhage,—only a little oozing from the ends of the bones, which will soon cease. I was not compelled to use a single ligature.

The wound is thoroughly irrigated with sterile water and then will be closed with silkworm-gut sutures. Irrigation is practised

simply to get rid of any bone-dust that remains. In this case the wound will be closed without drainage.

The leg is placed in an ideal position, just short of complete extension, and forced to heal in that situation by the application of a plaster-of-Paris dressing which will be allowed to remain for six weeks. A liberal amount of sterile gauze is first applied, then a layer of cotton, and over this the plaster. If a drainage-tube had been used, it would have necessitated changing the dressing at the expiration of forty-eight or seventy-two hours, which is undesirable.

After the dressing is completed we find the circulation in the anterior and posterior tibial arteries perfect, which means that I have not cut nor ruptured any of the vessels, and the integrity of the limb should not therefore suffer.

An operation of this kind would not be advisable in a man past forty years of age; but in younger subjects it should have the preference, as in the event of failure the operator could still resort to amputation. The mortality after an operation of this nature is, of course, not so great now as it was fifteen years ago, when it was estimated to be as high as fifteen per cent. If union occurs by first intention, that, of course, settles the question of mortality. If the patient escapes sepsis, pyæmia will be avoided, which is one of the chief dangers. If the operation is successful, the patient will thereafter be a bread-winner instead of a helpless cripple the remainder of his life. He will be able to take care of himself as well as anybody else. I was somewhat surprised that two most excellent surgeons had advised amputation in this case.

About the same amount of tissue was removed in this case as in the others, and the limb, as you see, is not appreciably shortened. During the first forty-eight hours after the operation the patient will suffer considerable pain, due to the tissues having been very much stretched and put in a new position, and it will be necessary to keep him under the influence of morphine. When plaster dressing, a heavy weight is attached to his leg so as to maintain extension. I did this in all of the other cases operated upon, with most satisfactory results. Nothing is so well adapted to the after-treatment of these cases as plaster-of-Paris dressings, and a weight (if necessary) to maintain extension.

[NOTE.—The dressing was not removed for six weeks, and when it was done union had taken place and the result secured excellent.]

INTRANASAL SURGERY, WITH SPECIAL REFERENCE TO NASAL DRAINAGE.

CLINICAL LECTURE DELIVERED BEFORE THE HOSPITAL GRADUATES' CLUB, NEW YORK CITY.

BY CHARLES H. KNIGHT, M.D.,

Member of the Kings County Medical Society, of the New York Academy of Medicine, and of the New York Pathological Society; Surgeon to the Manhattan Eye and Ear Hospital (Throat Department), etc.

GENTLEMEN,—No branch of medicine has undergone more remarkable development than that relating to diseases of the upper air-passages. In the last decade there has been a most extraordinary increase of rhinologists. The results of their activity are seen in scores of mutilated noses, whose function, except as tubes for the transmission of air, has been completely abolished. Innumerable turbinated bodies and septal spurs have been ablated by the enterprising specialist, who finds in every nose hypertrophies to be reduced or septal deflections to be rectified. The objects of this paper are to urge conservatism in the treatment of nasal lesions and to formulate the principles which should guide us in their management.

The nose is an organ of special sense, but its most important function relates to respiration. It is possible to get on very comfortably without the sense of smell, but much discomfort is caused by any impediment to nasal breathing.

The Schneiderian membrane is profusely supplied with glands, whose secretion lubricates the mucous surfaces and moistens the inspired air. It is essential that the normal disposition of this mucous secretion should not be interfered with.

The nervous supply of the lining membrane of the nasal fossæ is remarkably abundant, and a large number of remote disturbances known as "nasal reflexes" are caused by intranasal congestion or hyperæsthesia.

Finally, the nose is perhaps the most important feature in

giving character and expression to the face. The whole physiognomy may be altered by extremely slight changes in its size or contour.

Five conditions seem to comprise all the indications for surgical intervention in nasal disease,—respiratory stenosis, impairment of the sense of smell, interference with drainage, reflex neuroses, and external deformity.

There can be no difference of opinion as to the propriety of surgical interference when there is an obstruction to nasal breathing.

Stenosis interfering with olfaction *only* is rare. Anosmia may be a pure neurosis, and under such circumstances is of course not amenable to surgery.

The activity shown in the investigation of reflex neuroses has resulted in many indefensible, not to say ludicrous, conclusions. It is incredible how most of the diseases regarded as reflexes could have been seriously accepted as such. A genuine nasal reflex is rare, and it is not easy to cure. The majority of cases of nasal asthma, for example, receive temporary benefit from treatment, but are prone to recur.

How far the question of cosmetic effect should be considered is purely an individual matter concerning the patient. Distortion of the nose is sometimes so extreme as to be a source of mortification, or even an obstacle to earning a livelihood. Congenital malformation or local disease (such as septal abscess or syphilis) may be responsible for the deformity, and in deciding upon a method of relief it is important to take these factors into consideration. The destruction resulting from the constitutional disease is often so extensive that but little tissue is left with which to repair the damage. Moreover, the lowered vitality and feeble reparative power of syphilitics, combined with the well-known tendency to cicatricial contraction in this disease, offer serious obstacles in the conduct of such cases. Hence the importance of persistent treatment and prolonged exemption from symptoms before resorting to surgical measures of any kind in those known to have been infected with syphilis. Up to the present time no invariably successful method of treating the familiar deformity known as "saddle-back" nose, generally due to syphilis, has been devised. Artificial bridges and supports are worn with comfort in a small proportion of cases.

In others they act as irritants and have to be removed; if allowed to remain, there is danger of cutting through the skin over the dorsum of the nose. In case of congenital deformity, or depression resulting from abscess of the septum, the conditions are much more favorable. Here there is usually enough healthy tissue to permit an intranasal plastic operation, and artificial supports are more readily tolerated.

The question of *nasal drainage* is the most neglected, but by no means the least important, of the five indications to which reference has been made. The term is intended to include secretion not only from the mucosa of the nasal fossæ, but also from the lining membrane of the accessory sinuses, which is continuous with that of the interior of the nose. A synechia or septal deformity may be situated at so high a plane as to cause but few subjective symptoms apart from those due to retention of secretion. Most patients thus affected complain only of the usual symptoms of nasal catarrh. Not infrequently the inferior meatus is occluded by a septal ridge or an hypertrophy of the margin of the inferior turbinated bone, the space thus abridged being compensated for by a deflection of the septum to the opposite side at a higher level. There is no sacrifice of breathing capacity, and the patient may have no symptoms except those due to hyperæmia of an area of mucous membrane and accumulation of secretion always existing in cases of this kind. We meet with all varieties and degrees of obstruction, from that just described to complete obliteration of the nasal chamber by the development of masses of polypi. When hyperplasia of tissue occludes the middle meatus in such a way as to block the orifices of one or more of the accessory sinuses, we have the familiar signs of that complication. Still, they may be so slightly marked or so obscure as to justify the description of the condition as "latent empyema." Many cases thus reported in which the maxillary antrum is involved may be explained by a phenomenon repeatedly noticed,—namely, an overflow of secretion from the frontal sinus, the current, instead of passing to the nasal fossa, being diverted towards the opening of the antrum. A striking example has recently been reported by Schadle, of St. Paul, in which an "antral abscess at once got better" after the removal of an enormously enlarged middle turbinated bone which obstructed the duct from an inflamed frontal sinus. This writer remarks that "not infrequently a sup-

purating sinusitis heals spontaneously after the nasal stenosis is overcome and the choked orifice of the affected cavity is relieved." The practice of at once making an artificial opening in an accessory sinus found to contain pus is reprehensible. The logical and reasonable thing to do is to restore normal drainage. In a paper read before the Section in Laryngology of the Academy of Medicine a year ago I offered the following suggestion, which I have thus far had no reason to modify: "In all cases of pus in the maxillary sinus in which a diseased tooth is not an etiological factor, the proper course to pursue is to cut away all overgrowth of tissue in the region of the ostium maxillare, in order to restore normal drainage through the anatomical outlet of the cavity." At the time the observations upon which the paper just quoted was based were being made, a case of unusual interest came under my care. I shall venture to give a brief abstract of its history, although at first glance it seems to controvert my position.

The patient, a woman about thirty years of age, had a molar tooth removed from her right upper jaw in March, 1884. The tooth was broken and the jaw splintered in the process of removal. In rinsing the mouth immediately afterwards the fluid escaped from the right nostril. In a few days pus began to form; the alveolar opening closed and the nasal discharge became very profuse and offensive. In the fall of the following year a hole was drilled into the antrum from the mouth and daily irrigations were made for six weeks, when the discharge ceased, but only for a short time. The washings had to be resumed, and were continued without intermission for several years. The discharge then ceased and the patient had no further trouble, except when she caught cold, for a period of about five years. I first saw her twelve years after the extraction of the tooth. She was then in rather poor general health, was subject to attacks of what she regarded as "cold in the head" every three or four months, and was frequently conscious of an offensive odor in the nostril even when there was no secretion. She suffered more or less from hemicrania and from dull pain or a sensation of pressure in the antral region. Although I realized that this case was an unfavorable one for conservative treatment, I determined to avoid if possible a radical operation. Accordingly I cut away a large part of the middle turbinated bone and syringed out the antrum through the ostium. The subjective symptoms were

relieved, but the discharge persisted for several months. It gradually ceased, and disappeared for more than a year, when it recurred with an increase in the severity of all the attending symptoms. The antrum was then opened through the canine fossa by Dr. A. B. Duel, who found a calculous mass the size of a small bean lying in the cavity. This proved to be the fang of a tooth encrusted with salts. A drainage-tube, through which the antrum was washed, was worn for three weeks, and shortly after its withdrawal the opening closed. Since this time, more than six months ago, there has been no indication of trouble and marked improvement has taken place in the patient's general health. There is reason to believe that the cure will be permanent.

Had I not been especially interested in trying to cure abscess of the antrum by way of the nose at the time this case came into my hands, I should not have thought of resorting to the method in this instance. The result, of course, proved its utter impracticability. Still, the long periods of freedom from annoyance and the fact that the antrum had already been opened, presumably with opportunity for thorough inspection of its interior, led me to hope for a more fortunate outcome. In contrast with the foregoing case my records show several successful results, in which the trouble evidently began in the nasal cavity and was quite independent of dental disease.

Finally, I can only repeat my conviction that in all cases of antral suppuration in which we are satisfied that a foreign body, such as the root of a tooth or a splinter of bone, is not the source of mischief, and that the lining membrane of the cavity has not undergone serious degeneration, we are justified in attempting to secure relief by clearing away all obstructions from the region of the middle meatus. This method is far easier of execution and attended by less discomfort to the patient than the more formidable operation usually advocated and frequently required. The latter should be reserved for cases of undoubted dental origin; and even in these it is wise not to neglect the nasal fossa, since recovery may be no doubt expedited by thorough drainage. What has been said of drainage from the antrum applies with equal force to the other accessory sinuses. Measures directed towards the former more important cavity will at the same time in some degree relieve the frontal sinus and the anterior ethmoidal cells. Moreover, the ana-

tomical relations of their outlet are much more favorable to spontaneous evacuation of the products of inflammation when once an obstructing nasal overgrowth has been removed.

As to operative technique, it may be said that no one mode of operating is universally applicable. Jarvis, to whom we are indebted for the perfection of the cold-wire snare, was in the habit of using that instrument on nearly all occasions; and in my experience it has proved invaluable, not only in dealing with polypoid and hyperplastic overgrowths, but also in removing the anterior end of the middle turbinated body. In many of the latter cases the bone is so thin that the wire cuts its way through with great facility. In others the more powerful cutting forceps will be required. In septal deformities the saw, the chisel, or the drill may be preferred. Much will depend upon the shape, the size, the situation, and the consistency of the lesion to be attacked.

Although intranasal procedures are comparatively trivial, and may be properly classed with the operations of minor surgery, they should never be undertaken without a careful scrutiny of the general health. Should there be reason to suspect systemic depression, all surgical intervention must be declined or postponed until the general condition can be restored to a desirable standard, unless we are assured that the local disease is concerned in causing the condition.

APPENDICITIS; GALL-STONES; HARELIP SCAR.

CLINICAL LECTURE DELIVERED AT THE NEW YORK POST-GRADUATE HOSPITAL, JANUARY 10, 1900.

BY ROBERT T. MORRIS, M.D.,

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APPENDICITIS.

Gentlemen,—This first case that I operate upon to-day is of peculiar interest. The patient is a physician, thirty-four years of age. He enjoyed good health until June last, when there developed pain in the right side of the abdomen. It is unusual for the pain to be localized in the right side of the abdomen at the outset in these cases; it may be that, being a physician, he read his symptoms better than others. The pain lasted about ten days, but the patient did not go to bed. The second attack came on in August, lasting fifteen days. Then the pain was constant, with spasm of the abdominal muscles and slight elevation of temperature. The third attack occurred on November 17. It was more severe. Since the last attack he has lost flesh and has not been free from pain at any time. He had nausea, spasm of the abdominal muscles, but no vomiting, and no general peritonitis, and there has been no evidence of extensive infection at any time. At the time of examination the temperature was 99° F.; he had a slight cold, and it was thought that that might account for it. The colon bacillus temperature is usually between 99° and 101° F. A case may go on to a fatal termination with all the disturbances that accompany appendicitis, with a temperature ranging one degree on either side of 100; this is the colon bacillus temperature. I have made many temperature records, and have found that when staphylococci, streptococci, or mixed infection are present at the onset we are likely to have a high temperature, 103°, 104°, or even 105° F. The colon bacillus commonly controls the field after the first day, and the temperature drops when the colon bacillus displaces other bacteria; this accounts

for the temperature being not far from one degree on either side of 100 in most appendicitis cases. It is a good rule in these cases to make an examination of the pus in the laboratory. Now, in this case, the patient has had tenderness and pain in the right inguinal region ever since the last attack; the temperature of 99° I ascribe to his taking cold, because the colon bacilli will not persist for so long a time without causing less or more disturbance,—*i.e.*, they are either at rest or developing furiously. This means that in the interval between the attacks the patient's temperature is usually normal.

On palpation I do not find the appendix to be much enlarged; it really feels like a normal appendix, but is somewhat smaller than usual. If the patient were not a physician, and did not give such a good history of his case, I would hesitate about operating until I had seen him in an acute attack, or until I could palpate a distinctly pathological appendix. This patient came to me day before yesterday; the appendix was then harder and somewhat smaller than normal, but without active symptoms. I usually advise patients to allow me to be certain of the diagnosis before I operate.

The question that next arises is as to conservative treatment. We all know what the real conservative treatment is to-day; it is not a matter for discussion. It seems to me that at the present time we should be guided by a knowledge of the pathology of the disease rather than by personal experience. The time for that is passed. There are now few affections better understood than appendicitis. We know the causation thoroughly, the pathological changes thoroughly, the symptomatology thoroughly, and there is hardly any part of the entire subject not within our knowledge. I have operated upon many patients who were still being reported as cured by medical treatment. We know to-day that more than ten per cent. of all appendicitis patients have hard concretions in the appendix; we know besides that more than eighty per cent. of the patients who have had one attack have mucous inclusions more or less complete. This percentage does not include soft fecal masses, which predispose to appendicitis. Nature makes an effort to throw off this fecal matter, but I am sure than a good many cases are caused by soft fecal masses in the appendix. There follows a spasm of the muscularis of the bowel, which gives rise to a catarrhal inflammation with consecutive infection of the appendix. When the guarding epithe-

lium of the mucosa is damaged, infection follows. In the report of the cases treated without operation we note two points not usually brought out by writers. Most all of the patients who come to me after having had one, two, or three attacks give a history of ill-health dating from the time of their first attack; and yet they have continued to work, appeared to be quite well, were often congratulated upon escaping operation, etc. Inquiry reveals that many persons who report themselves in good health have had constipation or gas-formation, and do not feel vigorous or ambitious. They do not possess the energy they formerly did, and yet they say that they are pretty well. This condition of inferior health is due to several causes: first, it often follows infection from a mucous inclusion; secondly, it may be caused by adhesions of the bowel inhibiting peristalsis; thirdly, it is sometimes due to reflex disturbances of Auerbach's plexus and Meissner's plexus, fermentation taking the place of digestion.

There is not much difficulty in palpating the appendix; if one will give attention to it, he will soon become expert. I have no doubt that many of the class present can palpate the ovaries and tubes without difficulty; any one who can palpate the oviducts can palpate the appendix as well. To do it one must train the finger-ends. This matter of palpating the appendix should be acquired by every one who intends to express an opinion on the subject of appendicitis.

It seems to me that patients are always ready for an appendix operation. I count upon that fact in consultation. Usually it is the cook or the mother-in-law who is opposed to the operation, not the patient. I have been called to unravel this knot many times, and instead of arguing for several hours, at ten dollars per hour, I say, "Let us leave it to the patient." The patient usually says, "Operate." Of course, I am referring only to acute cases, cases in which there is an acute progressive inflammation. In interval cases I have frequently had occasion to ask for delay; in cases, for instance, in which the patients have had the management of large business affairs and who may ask for a delay of one, two, or three months; in these cases I often say, "Wait; we are ready to operate; but let me know at once if symptoms of acute recurrence make themselves known." But I cannot now recall a case in which when there was acute infection the patient did not say "Operate."

It is a common thing for patients to postpone operation because of the idea that they save time by delay. One of my patients, who was but nine days in bed after the operation, had previously been eight weeks in bed trying to save time. If operated upon, they usually spend but nine or ten days in bed, unless there be abscess complication at the time of operation.

Recurrence after abscesses have emptied into the bowel is a common experience. No one knows where the abscess is going to empty, whether into the bladder, into the iliac vein, or elsewhere, and yet the patient may have recurrence of the attack. This we know from the pathology of the disease. I had one patient, the sister of a physician, who after perforation of the lung discharged pus from the mouth and from the vagina at the same time; nearly a gallon of pus was thus evacuated. She recovered, and was congratulated, perhaps, upon escaping an operation; yet she had a subsequent attack, was operated upon, and the appendix was removed, and it was a fairly normal appendix. A mucous inclusion was present.

Patients suffer less under proper surgical treatment than under medical treatment. The replies of patients, ten in number, who had been operated upon were published in the third edition of my book on this subject: they all stated that they had suffered less under the surgical treatment than under any form of medical treatment. Several of these ten were abscess cases; one of them had had many attacks, and had been subjected to different kinds of treatment; and all gave testimony, which I published. After all, it seems to me that we should be guided by our knowledge of the pathology of the disease rather than by personal observation.

We know that if we operate in proper manner upon all cases so soon as the diagnosis is made, the death-rate is less than one per cent.,—that is, if the diagnosis is made before abscess formation has taken place. There is no medical treatment that gives like results. If the case has gone on to the formation of abscess, the death-rate, under proper treatment by competent surgeons, according to proved statistics, has been reduced to not far from five per cent.; there is no medical treatment in abscess cases that will give so low a death-rate as that; usually it is from twenty to forty per cent. The cases that have reached the stage of general septic or

suppurative peritonitis and have been treated surgically are not well classified for statistics.

In this case I shall make an incision one and a half inches in length; this is the incision which gives ample room for working with your fingers. A few years ago patients objected to long incisions, so I gradually reduced the length until I found that one and a half inches was the space required, excepting in abscess cases. I insisted upon this being taken as a standard, and directed physicians' attention to it at that time. It has had the effect of influencing operators to make shorter incisions, and patients do not now bear the ugly scars they formerly did.

In the early stages we never know when it will be necessary to operate, and that is the chief argument against waiting. None of us can tell just what the case is going to develop into; whether it will go on to abscess formation, maybe perforation. Delay makes the death-rate greater than it would be if operation is performed at once. If we wait for complications, we then work upon complicated cases.

Now, first, I will palpate the appendix. You first must palpate the ascending colon for a landmark; following it to the cæcum and then to the small intestine. If you cannot at once find the appendix, carry the fingers beneath the cæcum, and see if you cannot fix the appendix against the psoas or iliacus muscle, first steadying the bowel by pressing on the opposite side of the abdomen. The appendix is smaller than normal in this case, and most of it is replaced by connective tissue, and there is but little mucosa left.

Now let us operate and verify the diagnosis. Commencing at McBurney's point, I make an incision one and a half inches in length; I cut through skin and fat with the scissors, coming down upon the aponeurosis of the external oblique, which I split in the line of traction. I now split the internal oblique in its line of traction; then the transversalis, which brings us down to the peritoneum. A catgut ligature is passed through the transversalis fascia and peritoneum, which later will aid us in coapting and making accurate apposition, and leaving things as we found them. This longitudinal white band marks the colon; if I pull in the wrong direction, I will soon find fatty tabs, which lead to the omentum. Pulling in the right direction, we come to the bare cæcum. The appendix I find rolled up in its mesentery, with a few adhesions.

The appendix is small and hard at the points where there is connective-tissue replacement of mucosa. I shall now ligate the appendix. The peritoneum I shall scarify; it is difficult nowadays to set up a peritonitis without struggling for it. Now I am introducing a puckering-string suture, which goes through the peritoneum and muscularis, but not through the mucosa. I next ligate the stump, which guards against infection from the lumen side. The stump is inverted with a pair of forceps and the puckering-string tied. Aristol is placed on the site of the stump; and now I shall try to replace the structures of the abdominal wall in the same condition as I found them. The peritoneum is closed carefully to guard against properitoneal hernia; the muscles are sutured, and the skin is brought together by a subcutaneous suture. Do not attempt to suture the fat; atmospheric pressure will keep the fat in apposition. The time required for the chief operative work in appendicitis and gall-stone cases will average about twenty minutes to each case, if we exclude the time spent in closing the abdominal incision.

Examination of the appendix just removed shows a great deal of new connective tissue, in most places replacing the mucosa and leaving no lumen. This is a case undergoing the involution process.

CHOLECYSTOTOMY.

About one year ago this patient suffered from pain in the right hypochondrium, in the region of the gall-bladder. Eight months ago the pain increased at that point, with occasional spasm and firm contraction of the abdominal muscles of the right side, and the patient became jaundiced. These spasmodic attacks were accompanied by nausea. Gall-stones have apparently not been passed at any time. The patient says that he has lost flesh for several months, especially recently. The question of the diagnosis between the presence of gall-stones, malignant disease of the gall-bladder, and malignant disease of the pancreas came up. I could not palpate the gall-bladder. I had no chance to examine for fatty stools, to see if the pancreas was involved. He has had pain radiating to the right shoulder-blade, which is quite characteristic of gall-stones, and is also present in cancer of the liver.

The liver is small, but it has not the feel of a cirrhotic liver. It is difficult to find the gall-bladder; here it is, adherent posteriorly,

and quite full of gall-stones. The gall-bladder is now brought to the surface and fastened there. The liver here is probably congenitally small, with an abnormally deep fissure. If bile escapes in small quantities into the abdomen, no harm may result unless infectious material is carried with it. I will now open the gall-bladder; the bile is escaping in large quantities externally. With a long forceps I remove a large number of stones, probably a hundred or more; they consist apparently of nuclei of cholesterine covered by a dark layer of biliverdin. Aristol is placed thickly around the wound; it sheds liquid, and so protects surrounding parts from infiltration by bile. The gall-bladder is now flushed with saline solution, a twisted piece of gauze is introduced into the cavity, and the wound is closed with the exception of the drainage opening.

HARELIP SCAR.

The next case is a young man who had a harelip repaired years ago, and very well, but leaving a scar to the left of the median lip line, so that his moustache parts irregularly and shows the scar. I now put the scar in the middle line of the lip by making a slit on the right side of the lip corresponding to the scar on the left, cutting out the intervening segment, then suturing the wound again. This is the operation devised by A. M. Phelps.

CALCULUS IMPACTED IN THE URETHRA, REMOVAL BY SUPRAPUBIC CYSTOTOMY; VESICAL CALCULUS, SUPRAPUBIC CYSTOTOMY, SUTURE OF THE BLADDER; RETENTION OF URINE, CYSTITIS, ENLARGED PROSTATE.

CLINICAL LECTURE DELIVERED AT THE MOUNT SINAI HOSPITAL.

BY HOWARD LILIENTHAL, M.D.,
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CALCULUS IMPACTED IN THE URETHRA, REMOVAL BY SUPRAPUBIC CYSTOTOMY.

CASE I.—GENTLEMEN,—This patient, about twenty-seven years of age, strong, muscular, and well formed, was in good health until yesterday, when, after a short illness presenting the characteristic symptoms of renal colic, a sudden and painful stoppage of the stream occurred while urinating. He sought relief at the clinic of the Genito-Urinary Department of the Mount Sinai Hospital dispensary. Examination with the endoscope revealed a reddish calculus blocking the urethra in such a manner that it seemed probable that a portion of the stone projected into the bladder. On account of the spasm and the severity of the pain the patient was referred, as an emergency case, to the surgical department of the hospital. Believing that extraction through the urethra would be very difficult and probably dangerous, I decided to push the calculus back by passing a full-sized sound, and to extract it from the bladder by making a small suprapubic incision. There is no stricture and no posterior urethritis. I selected the suprapubic route rather than the perineal to avoid the possibility of causing sterility, possibly even impotence, which sometimes result as a consequence of perineal section. Although these accidents are rare, we should nevertheless take pains to avoid them, especially when the patient is young and presumably sexually vigorous. The perineal operation would, of course, be the method of choice if there

were any reason to suspect the presence of stricture or other disease of the deep urethra which might at the same time be benefited by this operation. The lithotrite might, of course, be resorted to, and the stone crushed and washed out of the bladder. As the calculus is small, and because general narcosis is indicated in any event on account of the patient's nervousness, I have decided to perform the quicker, and, probably, more radical operation of suprapubic cystotomy. The skin and the suprapubic region have been prepared in the usual manner. A soft-rubber catheter has been inserted into the bladder, the viscus emptied and filled with normal saline solution, which has been allowed to escape again. No ligature is placed about the penis and the catheter is not blocked or plugged. I make a vertical incision, not exceeding two inches in length, the lower extremity of which extends to the region of the pubic bone. Still keeping in the median line, the incision is carried through the aponeurosis between the muscles. This second deeper incision is not more than one inch and a half in length. The wound is held open by small blunt retractors, and the bladder is inflated with air from an ordinary atomizer-bulb attached to the catheter. I use air in preference to fluid, as the air-filled bladder, being relatively lighter than the abdominal contents, rises to the anterior abdominal wall and is easily reached without the employment of the troublesome and sometimes dangerous rectal bag. I do not fill the bladder with air before beginning the operation, but wait until the prevesical space has been opened. My assistant then slowly pumps air from the bulb into the bladder, and I can see as well as palpate the viscus as it fills. There is thus absolutely no danger of over-distending or rupturing the bladder. With the blunt handle of the scalpel I scrape the anterior vesical wall upward, and in this way detach the reflected peritoneum, which my assistant will now hold out of the way with a blunt retractor. Two silk sutures are put into the anterior wall of the bladder, no special care being taken to avoid perforating that viscus. These fillets of silk are placed about one-quarter of an inch apart, the needle being carried through the bladder in a vertical, not a transverse direction. The ends of each silk fillet are left long, and are knotted together so that by their aid the wall of the bladder may be drawn forward within easy reach of the knife. A small opening, not more than three-quarters of an inch long, is made between the

silk threads, which now, serving as retractors, are employed to draw the edges of the vesical wound apart. The finger inserted into the bladder easily detects the stone, and, you see, I have no difficulty in withdrawing it with a slender dressing-forceps. It is of a reddish color, cigar-shaped, about three-quarters of an inch long, and of the calibre, I should say, of a No. 34 sound. Evidently only one-third of the stone had projected into the urethra. There being no cystitis, I suture the bladder with fine silk, using hæmostatic needles and taking great care not to perforate the mucous membrane. It is not my intention to close the wound of the aponeurosis nor that of the skin. We thus avoid the possibility of danger from urinary infiltration in case there should be leakage from the bladder. The suturing of the bladder is easily accomplished when the viscus is drawn forward and steadied by the silk fillets. The suture is now finished and the bladder is once more distended with air, the abdominal wound being at the same time filled with liquid in order to be sure from the absence of escaping bubbles that the line of vesical sutures is sufficient. The silk fillets are withdrawn and the external wound is lightly packed with absorbent gauze. The catheter, held in place by strips of adhesive plaster, is to be attached to a tube passing over the side of the bed into a sterilized bottle for collecting the urine. The catheter should remain in place for five or six days during the healing of the vesical wound, in order that the bladder may be at rest. If at the end of a week there is no leakage and the tissues are in a healthy condition, the wound may be closed by means of a stitch or strip or two of adhesive plaster.

Two weeks after the operation this patient was discharged, the wound having firmly healed. The catheter was retained without urethral irritation for five days.

VESICAL CALCULUS, SUPRAPUBIC CYSTOTOMY, SUTURE OF THE BLADDER.

Case II.—The next patient, thirty-one years of age, is rather thin, but his general condition is good. His history until six months ago throws no light upon the case. At that time he began to suffer from frequent urination, more troublesome during the day than at night. He complained of pain referred to the end of

his penis, sudden stoppage of the stream, and, in short, the classical symptoms of vesical calculus without cystitis. He was admitted to the hospital a few days ago. According to our custom, he was treated for twenty-four hours by rest in bed and by the administration of fifteen grains of urotropin every morning after breakfast, so that by the time the first examination was to be made danger from possibly infected urine might be minimized. He was then examined with the solid searcher, the bladder, at the time, containing four ounces of fluid. A calculus, giving a clear metallic ring on impact with the instrument, was easily discovered. This calculus lay apparently in a sort of pouch or sacculation which it had made for itself in the trigonum. Bimanual examination with the finger of the left hand in the rectum and the right hand upon the suprapubic region failed to give information which might be of use; by this examination alone, in spite of the fact that the patient was a favorable subject, the diagnosis could not have been made. In cases of this kind, especially when the patient is an ignorant person, suprapubic cystotomy is to be preferred to litholapaxy, because it not only permits the complete removal of the stone or stones, but it also enables the operator to make a thorough examination of the interior of the bladder and to remove other morbid conditions that may be present, such as tumors or a diseased prostate, so often the cause of stagnation and consequent calculus formation. With intelligent patients who can be made to understand the surgeon's object, litholapaxy will often be the operation of choice. As the urine of this individual is clear and contains no mucus, we are free to assume that there is no cystitis.

After the usual preparation the bladder is emptied by means of a soft catheter, and is flushed with a saline solution. The successive steps of this operation are practically the same as in the preceding case, except that the incisions, both through the skin and deeper structures, are considerably longer, say, three and two inches respectively. The peritoneal reflection here extends very low,—practically to the pubes,—and notwithstanding the absence of cystitis the peritoneum is quite firmly adherent to the bladder wall. The bladder can be seen to rise up well when distended with air, but even when the viscus is rather tense it is difficult to push the reflected peritoneum up out of the operative field. If I should injure the peritoneum, I would simply close the wound with run-

ning catgut sutures and proceed with the operation. Fortunately, I have been able to avoid this accident, and the bladder wall is now freely exposed. Incision shows that the wall is not thickened. On inserting my index-finger, I with difficulty reach the calculus, which lies behind the prostate at the greatest distance possible. There is some slight difficulty in grasping it with the dressing-forceps guided by the finger; but, finally, I am successful, and have delivered it. It is light in color, very smooth in shape, an almost perfect flattened oval, and so hard that the dressing-forceps scarcely made an impression upon it. It is one and seven-eighths inches long, one and a half inches wide, and five-eighths of an inch thick. I shall close the wound in the bladder by means of a purse-string suture of catgut. This can be easily done with the aid of the silk fillet, by which the viscus is drawn towards the surface. My assistant inverts the mucous membrane with the help of the mouse-toothed forceps as I tighten and tie the suture. I shall leave the tissues anterior to the bladder unsutured, as in the last case; but instead of packing the wound with gauze, I insert a layer of gutta-percha tissue, and upon this, as in a bag, I place loose compresses of gauze. The gutta-percha tissue will not adhere to the sutured bladder, and can be removed without danger of tearing open the visceral wound.

The catheter was retained five days, when irritation of the urethra necessitated its withdrawal. There was no leakage from above. After the removal of the catheter the bladder was emptied with a soft-rubber instrument every three hours, day and night, for the next three days, when union had become firm. Two weeks later the patient was discharged from the hospital well.

RETENTION OF URINE, CYSTITIS, ENLARGED PROSTATE.

Case III.—We have here a man, sixty-five years old,—much older to judge by his general appearance and the condition of his arterial system,—who was admitted to the hospital four days ago as an emergency case, suffering from a greatly distended bladder and complete retention of urine. It was his first attack of retention, although for some years there had been frequent urination and irritability of the bladder. In patients of this class it is not always possible to gain satisfactory information as to previous illness, so I am unable to say whether or not there has been anything

in the past which might bear upon the present condition. The patient being in great distress, the house-surgeon at once attempted to relieve him by catheterization, using at first a medium-sized soft-rubber instrument, and, this failing, a woven one, then a Mercier catheter, and, finally, the smallest sized woven catheter. Attempts had been made at catheterization before the patient was admitted to the hospital, and evidently one or more false passages had been made. At any rate, the house-surgeon's efforts were rewarded with blood and not with urine. I was consulted by telephone and advised the careful introduction of a well-lubricated, large-sized, say, No. 20 French, metallic catheter. In the event of failure under gentle efforts an immediate suprapubic aspiration of the bladder was to be performed. The metallic instrument passed with ease and the patient was relieved. He has since been catheterized with the same instrument every three hours, day and night. Frequent complete emptying of the bladder is a form of treatment which I consider of the greatest value in preventing, and even curing, putrefactive cystitis. Urotropin was administered daily. The patient has not been able to void his urine voluntarily since his admission to the hospital, and attempts at catheterization with the soft instrument always cause hemorrhage. Examination by the rectum reveals a soft, moderately enlarged prostate. I shall perform suprapubic cystotomy as the first step of operative procedure on account of the opportunity for thorough examination it affords, and because the prostate may then be treated either by excision or cauterization. Besides, we are not sure that stone may not be present, and a suprapubic incision is the safest method of extraction, as the patient is unable to empty his bladder and septic urine is present. The man, as you see, is much emaciated. He has not been catheterized within the last three hours, so we are sure that there is some urine in the bladder. I shall now first attempt to introduce a soft instrument for the purpose of washing out the bladder and distending it with air in the usual manner. Perhaps, the patient being anæsthetized, I may succeed where the house-surgeon failed. Blood follows the introduction of the instrument, and, as I do not care to waste time and perhaps increase the traumatism already present, I shall ask my assistant to give me the catheter with which the patient has been relieved during the past four days. This passes readily, and about seven ounces of foul-

smelling urine are voided. The bladder is washed out with saline solution and the catheter left in place for pneumatic distention. The usual suprapubic incision is now made, disclosing a closely adherent fold of reflected peritoneum. Stripping this up from the air-distended bladder exposes the cystic wall, in which large veins are observed to ramify. I have now inserted a silk fillet, but the bladder wall seems to be enormously thickened, and I question whether the needle perforates the mucous membrane, though it passes deeply into the vesical parietes. Incising the bladder with the scalpel, we see that its walls are, at least, one-half an inch thick. The wound in the bladder is now drawn to the surface by retractors, in order to facilitate observation of the trigonum and the prostatic region. We will elevate the foot of the table and put the patient in what is known as the Trendelenburg position. This affords an excellent view of the interior of the viscus. We see the trabecular appearance of the hypertrophied bladder, and considerable thickening of the mucous membrane in the region of the prostate at either side of the internal urethral opening. There is no "middle lobe." The moderate hypertrophies are very soft, and perhaps on account of their softness form a perfect valve, at once explaining the condition of retention. We will now temporarily pack the bladder, place the patient in the lithotomy position, and perform perineal section, in the hope that we may be able to extract the prostate through the opening thus made. I make the perineal opening by a transverse curved incision between the tuberosities of the ischii with the convexity anterior. Dividing the muscles which form the floor of the pelvis, I easily reach the prostate, which the finger of my assistant, introduced in the bladder, forces into the wound. The prostate is very succulent, not fibromatous, and cannot be satisfactorily enucleated. I shall, therefore, deeply cauterize both lobes with a Paquelin's point through the suprapubic wound, make a perineal urethrotomy for drainage, and close the suprapubic vesical wound by sutures, to avoid the formation of a fistula, a complication which is often troublesome and persistent in old and badly nourished individuals. Cauterization of the prostate may be thoroughly performed under the guidance of the eye when the patient is in the Trendelenburg position and the wound is well distended by blunt retractors. I have deeply cauterized each lobe of the prostate, and I shall now proceed to suture the wound in the

bladder, which I prefer to do in this instance with moderately thick chromicized catgut. The bladder is so hypertrophied that I fear, in the event of occlusion of the tube below, from blood-clot or other cause, the viscus may be excited to muscular contraction and thus tear out the sutures. I therefore put in this double tier, which I think will guard against leakage. This patient, perhaps on account of his emaciation, has a very lax abdominal wall, and the space between the bladder and the parietes is very large. This is an additional reason for closing the bladder by suture, for there is danger in case of a leak that disastrous urinary infiltration of the prevesical space may occur. A light packing of gauze in the suprapubic wound and firm strapping of the skin with plaster complete the dressing. The dressing of the perineal wound consists of a very light packing with a T-bandage, the tube emerging through the tampon. A transverse perineal wound falls together quite naturally when the patient lies upon his back with the legs extended.

Two weeks after the operation the patient was still in the hospital, but out of danger. For ten days he was in a very weak, miserable condition with diarrhœa and subnormal temperature, but with no clinical symptoms of sepsis. The urine, which he passed freely, rapidly cleared up, until now mucus has entirely disappeared and the pus present is referable to the unhealed wounds in the diseased bladder. The drainage has been perfect, and there has been no leakage from the suprapubic vesical wound. The tube is still in place, so we are unable to give the final results as to the re-establishment of the function of micturition.

Obstetrics and Gynæcology

SECONDARY POST-PARTUM HEMORRHAGE.

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Post-partum hemorrhage is a complication of the lying-in period which always brings immediate danger to the mother and much anxiety to her medical attendant. This is especially true of the form termed secondary post-partum, for in it the hemorrhage supervenes at a time when all fear of such an occurrence has commonly been allayed, and when the obstetrician is no longer in constant attendance upon his patient. There can be no doubt that uterine bleeding coming on at any period after the first twenty-four hours of the puerperium has a gravity and even a terror peculiarly its own. In the two cases about to be narrated the hemorrhage occurred in one on the sixth and in the other on the ninth day of the puerperium, and in both instances gave rise to grave symptoms which in the former terminated fatally and in the latter case ended in recovery.

Case I.—On June 29, 1899, at 2 p.m., I was hurriedly summoned to a case of post-partum hemorrhage occurring in a patient of Dr. Arthur Wilson. The message was that it was a serious case of secondary post-partum hemorrhage, and that it would be necessary to bring transfusion apparatus. When I reached the patient I found Dr. Wilson and another practitioner in charge. They had employed the ordinary means of checking the hemorrhage, but without success, and the woman was moribund. I had just time to begin the injection of saline solution into the bowel when I noticed the rectal sphincters give way, and at the same moment one of the physicians present said, " She is dead," and it was so.

The history of the case was as follows: Mrs. Y., aged twenty-nine, a primipara, had enjoyed good health before her marriage, with the exception of an attack of kidney disorder when she was twenty; but she became more robust afterwards, for she was able to take more exercise, being no longer employed in a shop. During pregnancy she was in excellent condition; she put on flesh, never had an ache, was healthier than she had ever been in her life, and was able to do all her housework. Previous to marriage there was sometimes an interval of six weeks between her menstrual periods, and some pain was experienced during the first day of the flow. Like many young wives, she had the fear that she would not get over her confinement. The urine was tested each month during pregnancy, and on no occasion was albumen found. For a month before delivery she was given quinine and strychnine. The labor, which occurred on June 23, 1899, at full term, was natural; its duration was ten hours; the head presented in the occipito-left-anterior position. No interference was needed, and the placenta came away in ten minutes with scarcely any bleeding. There was no retained placenta or clot. There was a laceration in the cervix about a quarter of an inch deep, and smaller than that usually seen in primiparæ. Further, she was a total abstainer; there was no family history of hæmophilia and no evidence of malaria or anæmia.

The first five days of the puerperium were uneventful. She nursed the baby, the bowels moved, and there was certainly no fæcal accumulation, and no history of exertion or emotion. On the sixth day of the puerperium she was singing to her baby and chatting with her husband at 9 A.M. At 10 A.M., when her nurse was preparing to douche her, but before the douche-tube had even been introduced, she had a rigor. The nurse gave her a hot drink, covered her with blankets, and placed hot bottles about her. Dr. Wilson was in attendance at 11 A.M. He found her flushed, perspiring freely, and with a temperature of 103° F. This was the first time the temperature had risen. What he particularly noticed was the scared expression of the patient,—she looked terror-stricken. He examined her, and found the uterus distended with clots; these were cleared out and a hot antiseptic intra-uterine douche was given. The uterus contracted firmly at once and the bleeding stopped. Ergot and strychnine were given by the mouth, and one-one-hundredth grain of ergotinin hypodermically. In half an hour the

uterus again became distended; the same treatment was followed, with the same result; then bleeding began again. Nothing was retained in the uterus, a fact of which both Dr. Wilson and Dr. Armour (the other medical man called in) were quite sure; there was only a small tear in the cervix, and it was not bleeding. The hemorrhage could be stopped for the time, but could not be permanently arrested, for the uterus slowly relaxed and felt like a sponge under the hand, and that even with one hand externally and the other in the vagina. Four times this happened before my arrival, and when I examined the patient the uterus was fairly firm and lying in the pelvis. As I already stated, I had only time to begin the administration of saline solution by the bowel when the patient died.

Unfortunately, a post-mortem examination was refused,—a refusal which the husband regretted very much a fortnight later, when the first paroxysm of his grief was over,—so that a certain amount of mystery must remain associated with this truly tragical case. To the question of its causation I shall return after I have described a second case of late puerperal hemorrhage, which in some respects exhibits a marked contrast to the one to which reference has just been made.

Case II.—Mrs. N., a primipara, was confined on September 27, 1899, being then twenty-four days past the calculated date of delivery. The labor was difficult, the head requiring to be expressed through the vulva with the help of the fingers in the rectum. After the expulsion of the placenta by expression it was found necessary to remove a portion of the membranes from the uterus with the fingers; it is possible that another smaller portion may have been left, although nothing was felt in the uterine cavity at the time. The early days of the puerperium were quite normal. On the eighth day the patient got up to have her bed made, at which time the discharge had almost ceased. On the evening of the ninth day she rose for about two hours, but hemorrhage came on in considerable amount with clots. She was sent back to bed, was given ergot, and had a hot douche administered. The discharge soon stopped, and she remained in bed till the twelfth day of the puerperium; but again on rising she suffered from a return of the hemorrhage, although it was of a less severe type. The next day there was again a return of the discharge, so the patient remained in bed till the sixteenth day, when she rose for a short time, again to suffer from

a slight return of the bleeding. The discharge did not entirely cease till the end of the month. These recurring hemorrhages were quite free, and on one occasion the patient nearly fainted. There were no signs of septic infection, and indeed the puerperium was otherwise quite normal. A dose of ergot had been given at the termination of the labor. It is noteworthy that the patient states that her mother had a similar experience after one of her confinements.

Secondary post-partum, or puerperal, hemorrhage is bleeding from the uterus coming on after the first day of the puerperium, but within a month from the date of the confinement. It is of less frequent occurrence than the third-stage, or ordinary, post-partum hemorrhage, but it may, as seen in the first case narrated, be equally dangerous and fatal. On the boundary-line between these two forms of post-partum bleeding are the cases in which uterine retraction is incomplete or temporary, and a sort of secondary inertia uteri sets in some three or four hours after delivery; this is accompanied by a certain amount of bleeding, often concealed at first and retained in the distended uterus. The patient complains of faintness, and the pulse will be found to have become rapid, running up to ninety or a hundred or more; and then, when urine is being passed, or independently of micturition, a large clot is expelled from the vagina. Such cases are not uncommon in multiparous patients, and I have recently observed one instance in a secundipara who had a free third-stage hemorrhage due to a very large placenta and uterine inertia. In this case the uterus after labor did not assume the round, firm form which we associate with safety (*le globe de sécurité* of the French obstetricians), the fundus remaining somewhat flat. The uterus was compressed for three hours after labor, yet at the end of six hours a large—indeed, an enormous—clot was passed, and further pressure on the fundus was needed for two hours longer before the patient could be safely left. This was not true secondary post-partum hemorrhage, but rather a delayed form of ordinary post-partum hemorrhage, which a little longer delay would have converted into true secondary post-partum bleeding. Its treatment is expression of the clot, the hot douche, ergot hypodermically, and steady and often long-continued compression of the uterus until it assumes the form of safety.

True secondary post-partum hemorrhage may be caused by a

number of different conditions; and it is not often possible during the bleeding to decide from the history of the case or from the symptoms present which of the causal conditions is operative. After the termination of the case, either in arrest of the bleeding or in death, it is not always easy to arrive at the etiology, as was shown in Case I. Yet it is of the greatest importance that the cause be ascertained if the treatment is to be effectual.

In one group of cases there is the retention of a piece of placenta, such as a succenturiate lobe, or a fragment of the membranes. This seems to have been the cause in the second case which I have reported; and it is the factor which ought to be borne in mind when there is a history of difficulty in removing the placenta or membranes. The hemorrhage may apparently be due either to the presence of the separated fragment acting as a foreign body or to the actual separation of the piece of placenta allowing bleeding from the uterine wall. In certain cases signs of septic infection may be superadded to the bleeding, which then ceases to be the most important phenomenon. This form of post-partum hemorrhage ought not to occur if proper supervision of the third stage of labor has been insisted upon, and it has been ascertained that all the afterbirth and membranes have been removed. The presence of a succenturiate lobe may, however, upset all calculations and defeat the best-conceived prophylaxis. The treatment consists in giving a hot vaginal douche and the administration of ergot hypodermically; but if the hemorrhage persist, and more especially if there be also signs of septic infection, then the interior of the uterus ought to be explored with the finger (with previous dilatation if need be), and the offending fragment of placenta or membranes removed.

In another group of cases the hemorrhage is due to lacerations in the vaginal tract or to rupture of a vaginal hæmatoma. These may be diagnosed by the examination of the genital tract with the fingers and speculum; and such an examination ought always to be made if there be any doubt about the source of the bleeding. Deep cervical lacerations, as well as extensive perineal and vaginal tears, will usually give rise to hemorrhage at an earlier period in the puerperium than the second day; but occasionally the bleeding from them is truly secondary or puerperal. Plugging the cervix or vagina, or both, with iodoform gauze will often be sufficient to check this form of hemorrhage; but if this fail it may be necessary

to expose the laceration, whether in cervix or in vagina, and bring together the margins with sutures. Vaginal hæmatoma is a rare and little-understood complication of the puerperium. When it occurs it may rupture and give rise to alarming bleeding. I have not met with such a case in the puerperium, but have seen an instance of it in the second stage of labor.[1] It will be necessary for treatment to clear out all clots from the hæmatoma cavity and bring together the edges of the tear with sutures; some bleeding vessels in the cavity may need ligature.

In a third group of cases the secondary post-partum hemorrhage is to be ascribed to displacement, especially to fixed displacement, of the uterus. The displacement may occur after labor and take the form of a retroversion or flexion. If its occurrence be suspected, it is easy to make the diagnosis, and replacement is usually quite possible, for there is no fixation; a large pessary may have to be worn for a week or two.

There is another form of uterine displacement, an example of which I met with last winter, which may also set up troublesome although not very severe hemorrhage in the puerperium. It is that in which prior to labor—and also to pregnancy—the uterus has been fixed in a position of anteflexion (pathological anteflexion); the parts become stretched to some extent by the physiological changes of pregnancy, but labor is delayed and has generally to be terminated by the help of forceps, and a red discharge continues from the uterus for many weeks after delivery. In the case to which I have referred it lasted for two months. The condition is a difficult one to treat effectively. I have found prolonged rest in bed, and hot vaginal douching associated with blood tonics, such as iron and strychnine, to have a good effect, but convalescence is always much retarded. I need only mention inversion of the uterus as another form of displacement which may cause hemorrhage in the puerperium.

In a fourth group of cases may be placed the hemorrhages due to such accidental circumstances as sitting up suddenly in bed, violent mental emotion, straining at stool or in micturition, rising from bed too soon in the puerperium, and the early resumption of sexual intercourse or of occupation of the same bed. It is not often easy

[1] Scottish Medical and Surgical Journal, vol. vi., 505, 1900.

to assure one's self of the incidence of any of these causes. They are, however, avoidable, and ought to be prevented.

The fifth group comprises such local and general causes of pelvic congestion as uterine fibroids and polypi, cancer of the cervix, a loaded rectum, a distended bladder, and cardiac, renal, and hepatic disease. The failure to find any other cause of uterine hemorrhage should make us suspect the existence of one or other of these congestion-producing conditions; the appropriate treatment of the condition will then be evident.

Finally, there is a sixth group, to which belong the cases in which a considerable blood-loss from the uterus occurs near the end of the first month after labor, and in which it is reasonable to ascribe the incident to the return of menstruation, possibly increased in amount by some concomitant condition, such as subinvolution of the uterus or constipation. It is well, therefore, to ascertain from the patient on what date her menstrual flow may be expected to return, for in this way the diagnosis may be cleared up and no little anxiety both to patient and to practitioner may be avoided.

Such are the etiological groups into which cases of post-partum hemorrhage may be divided: (1) Retention of membranes, placental fragments, or clots; (2) lacerations of the genital tract; (3) displacements, especially fixed displacements due to pre-existing perimetritis or cellulitis; (4) accidental and traumatic conditions; (5) pelvic congestion due to local or general causes; and (6) return of the menses.

The second case referred to in this lecture may with considerable probability be placed in the first group, for there is a strong presumption in favor of the retention of a piece of the membranes. With regard, however, to the first case, there is no such probability; indeed, the causation of the hemorrhage is wrapped in much mystery. The causes enumerated in the first, second, third, fifth, and sixth groups can all be excluded with almost absolute certainty, although from the fact that the hemorrhage was accompanied by a very considerable rise in temperature it is within the bounds of possibility that the cause may have been the breaking down of an intra-uterine thrombus through sepsis. Putting the septic hypothesis aside, we are thrown back upon the fourth group of etiological factors. Some of these we can also exclude, such as exertion, violent emotion, getting out of bed too soon, resumption of cohabita-

tion, etc.; but it has to be borne in mind that after the occurrence of the rigor the patient beeame terror-stricken, and in the state of abject fear in which she found herself it is possible that at least the cause of the continuance, if not the beginning, of the hemorrhage may be sought. The patient dreaded a fatal issue to her case, and had been speaking of it to her husband on the day preceding her death; the supervention of the rigor would immediately lead her to believe that what she feared was coming to pass; she became demoralized through fear, and in this way the whole vasomotor system was almost paralyzed, and what might otherwise have been a temporary and slight hemorrhage was converted into a prolonged and fatal bleeding. The uterus itself was evidently in a state of complete inertia. The influence of fear in connection with the hemorrhages of labor and the puerperium is, I am sure, not to be neglected, and I have recently met with two cases of third-stage bleeding with uterine inertia in which I am certain this factor came into play. In one of these the nurse alarmed the patient by very audibly asking me if I thought the bleeding would be fatal, and for a time it looked as if it might be; in the other case, in which the patient was the wife of a colleague, the presence and evident anxiety of the husband, medical man although he was, had an undoubtedly prejudicial effect upon the bleeding and markedly increased it. Further, a case of true secondary post-partum hemorrhage has recently been recorded by Dr. H. West,[1] in which a patient nearly died of bleeding on the sixteenth day of the puerperium as a consequence of great terror caused by the attempt of a man to break into the house where she was. If fear, then, were the cause of or contributed to the fatal hemorrhage in the case narrated by me, what conclusion is to be drawn as to the proper treatment to be adopted? Undoubtedly it seems reasonable to recommend some sedative, such as opium, or even hyoscyamus or belladonna, which were formerly frequently used by physicians for the checking of bleeding in nervous, excitable individuals. Even stypticin might meet the indication, being a sedative rather than a styptic.[2] The injection of saline infusion hypodermically would in the mean time serve to restore the equilibrium of the circulation.

[1] Australasian Medical Gazette, vol. xviii., 817, 1899.

[2] "Hæmostatics in Gynæcology," Scottish Medical and Surgical Journal, vol. vi., 183, 1900.

PHLEGMASIA ALBA DOLENS.

CLINICAL LECTURE DELIVERED AT THE BAUDELOCQUE CLINIC, PARIS.

BY A. PINARD, M.D.,

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GENTLEMEN,—The history of a woman who entered our wards not long ago, and who to-day leaves us in good health, enables me to bring to your notice certain phases of phlegmasia alba dolens following childbirth, and briefly to review the treatment now used in this disorder. Let me first read you the notes of this case.

The patient is twenty-seven years of age, and was pregnant for the sixth time. Her previous pregnancies were attended by the following abnormal incidents:

The first: albuminuria during the seventh month, for which she was put on a milk diet; the child was born at full term and lived; four hours after the confinement patient had a serious hemorrhage.

The second: spontaneous delivery at term, the child lived; immediately after delivery, serious hemorrhage.

The third: the same as the second.

The fourth: miscarriage at two and a half months, cause unknown, sequelæ normal.

The fifth: the same as the fourth.

As regards her recent pregnancy, the last period occurred September 15 to 25. On October 19 she lost blood for three hours, and from that time she had a uterine hemorrhage almost every day. Her physician advised hot douching and rest; but she continued to work as a washerwoman, taking the douches only. During the night of December 22 a more profuse hemorrhage accompanied by painful uterine contractions occurred, and a miscarriage followed. Her physicians gave her mercuric chloride douches and endeavored to extract the placenta, but failed. Each morning for five consecutive days unsuccessful attempts to remove the placenta were made. He then called in another practitioner, with no better

results; and as the woman's temperature had begun to rise they advised her being brought to our wards, where she arrived at ten o'clock on the morning of December 29.

She was at once examined by my chief of clinic, who found the pulse to be 120 and the temperature 38.8° C. (about 102° F.); he therefore decided to empty the uterus without further delay. After having disinfected the region he examined the cervix, which was found to be widely dilated; inserting his hand into the vagina he passed two fingers into the uterus, his other hand pressing down the uterus, which rose about to the umbilicus from the outside. In this way he succeeded in separating the placenta, which still adhered closely, after which he curetted the cavity with the usual antiseptic precautions.

Let me impress upon you in this connection that in similar cases instruments should not be used in separating and extracting the placenta. The cervix being open, or having first been dilated, with or without anæsthetics, two fingers of the hand inserted into the vagina can be insinuated into the uterus, and, the other hand holding the uterus in place through the abdominal wall, the placenta may be removed without any risk whatever. This is the method I invariably use, and I cannot recommend it too highly.

At one o'clock the same afternoon the patient had a violent rigor; her temperature was then 39.6° C. (104° F.), and her pulse 140. The evening temperature was 38° C.; and on the following day it fell to normal and the pulse to 68. This condition lasted several days.

But on January 5, although both morning and evening temperatures were normal, the patient noticed a peculiar sensation in the left lower limb,—it seemed numb and powerless. On the 7th, œdema of the entire limb appeared, and the leg was then put in a cradle with the heel slightly raised. In addition to this I prescribed an injection of thirty grammes (one ounce) of Marmorek's antistreptococcic serum A.

The patient's condition was the same on the 9th, but during the forenoon of the 10th she spat blood twice, and at three o'clock in the afternoon she showed signs of suffocation and felt a sharp stitch in the side below the left breast in the sixth intercostal space. Dry cups were administered; the temperature was 38.5° C., the pulse 104.

On the 11th pain was felt in the left calf, but only on pressure; the circumference of the left calf measured 31 centimetres, that of the right, 28. The stitch in the side had disappeared, and the blood in the sputum had changed in color from red to black and was becoming scanty.

January 12, another ounce of serum was given. January 13, left circumference 30 centimetres; right, 28.

From that time on the patient's condition improved, her temperature fluctuating irregularly between 37° C. (normal) and 38.4° C. until January 20; it became entirely normal between January 21 and 26.

At 4 A.M. January 26, a sudden pain was felt in the right leg, with irradiations towards the pelvis, and the patient found that she could not move that limb. Slight œdema was detected on the anterior face of the tibia, and the temperature was found to be 39.8° C. (104° F.). The leg was immediately put in a cradle and raised, and forty grammes (one and one-third ounce) of serum A were injected morning and evening. This dose was repeated twice on the 27th and again on the 28th.

On the 29th the patient complained of difficulty in breathing, but less severe than that which occurred on January 10, and also of epigastric distress; moreover, she coughed up red sputum from time to time. She had no stitch in the side, but she frequently vomited matter slightly streaked with blood. Her face was pale, the œdema of the leg had increased, and the limb was painful in its entire length.

Oxygen was administered. The dyspnœa lasted three days, but the red sputum continued for some time, the color changing to black as it disappeared. The temperature then fell to the normal and remained so during the whole of February.

March 10. The patient got up on the thirty-first day after the temperature had fallen to the normal; she felt no inconvenience other than a certain amount of stiffness in the legs, and was able, with assistance, to take a few steps in the wards.

The history of this case, gentlemen, is a very complete outline of the usual course of a favorable case of phlegmasia alba dolens after childbirth. I use this term purposely, and wish to call your attention to it, as there is even yet a certain amount of confusion connected with the names given to the disorders of the

veins observed during the puerperal state, which is referable to the early pathogenic and etiological conceptions on the process,—conceptions of which I shall give you a short sketch.

Puzos (1759) was the first to separate from the different forms of swelling of the legs that may occur during pregnancy or after confinement the *painful* swelling of the leg and thigh, and to make of it a morbid entity, which he attributed to metastasis of the milk, and which he thought could occur either during pregnancy or after delivery.

White (1784) claimed, without, of course, any proof on which to establish his theory, that the immediate cause of the disorder was an obstruction to the flow of the lymph in the limb, whence followed retention and accumulation.

After him, Davis (1823), in his famous paper, proved with facts at hand that the fundamental lesion of the disorder was localized in the veins.

We may pass over in silence the names of the physicians who regarded this disorder as a disease of the nerves of the thigh, a rheumatic or other actual inflammatory condition, and say that the *primitive phlebitis* theory, based on the researches of Cruveilhier and other pathologists, was accepted almost without opposition until it was replaced by that of thrombosis, as the result of the labors of Bouchut (1844) and, more particularly, of Virchow (1856). This new conception, however, only transferred the problem to different ground and added new difficulties to it. The origin of the clot remained to be explained. Furthermore, it had to be admitted that this phlebitis was not peculiar to women after childbirth, since with clot formation phlebitis had been observed in women with cancer, tubercle, etc. This is why Troisier, in his remarkable thesis of 1880, which contains the most reliable and complete data concerning the history of this disorder, wrote with truth that the pathogenesis of phlegmasia alba dolens was far from being elucidated, and that every phase of this question was based on pure hypothesis.

It was not until 1889 that the parasitic origin of this disorder, which had been suspected by Doleris in 1880 and mentioned by Hutinel in 1883, was demonstrated by Fernand Widal. Subsequent research has confirmed Widal's ideas and strengthened his conclusions; so that we may say that to Davis is due the credit of showing that phlegmasia alba dolens is a disease of the veins; and

to Widal that of proving that the *Streptococcus pyogenes* is the cause of that disease.

For these reasons phlegmasia alba dolens should be defined as a form of infectious phlebitis of uterine origin. This definition distinguishes it from other forms of phlebitis, and shows that it can only appear after childbirth and never during pregnancy. The conception of it in vogue since the time of Puzos, that it might appear during pregnancy, is erroneous. At any rate, the cases (with the exception of those of Puzos, who confused the different varieties) on which these writers relied must be very rare, since Troisier cites only one, and it is only necessary to read it to be convinced that it was not a case of phlegmasia at all.

But although phlegmasia alba dolens cannot occur during pregnancy, it is evident that it may appear after a miscarriage as well as after confinement, and this case is an illustration of this fact.

In regard to the pathogenesis and etiology of this disorder I may add, in conclusion, that the patient's constitution plays a leading part, as is shown by the recurrence of the disorder after each confinement, and the frequency with which different women belonging to one family fall victims to it after childbirth.

The differential diagnosis of the complaint I shall pass over to come to the treatment, which should be prescribed as follows:

Curative Treatment.—1. Immobilize the limb in a cradle on an inclined plane.

2. Allay pain, when it exists, by injections of morphine.

3. Inject antistreptococcic serum as long as there is excessive elevation of temperature.

4. Wrap the limb in cloths wet with a saturated solution of ammonium chloride until an eruption appears.

5. Keep the patient in bed for a month after the last rise of temperature connected with the subsidence of the phlegmasia.

6. Require the patient to wear an elastic stocking as soon as she gets up.

Prophylactic Treatment.—1. Strict antisepsis during confinement, particularly in the case of women predisposed to infection,—those who have had albuminuria, hemorrhage, etc.

2. Prophylactic injections of antistreptococcic serum in those cases in which phlegmasia alba dolens has followed previous confinements.

RECIPROCAL RELATIONS OF GYNÆCOLOGICAL AND NEUROLOGICAL DISEASES.

BY CHAUNCEY D. PALMER, M.D.,

Professor of Gynæcology in the Medical College of Ohio; Obstetrician and Gynæcologist to the Cincinnati Hospital.

It is a mistake to consider gynæcology as an exclusive specialty, for none such can really exist. No local disease is without its constitutional relations; every constitutional affection must have some local expression. Virchow has well said, "A man cannot be a thorough specialist who is not a good physician."

There is no more significant fact in gynæcological practice than that the nervous system of women is different in kind and in quality from that of men. Women have an organization of the nervous system more complex and more sensitive, a sympathetic system more highly developed. This is most noticeable because of and during her menstrual life, and especially during her menstrual epoch. We prescribe no medicine, we determine the choice of time for no surgical operation that we do not at the same moment consider the functions of the ovary and the uterus. Her sexual sphere predominates. Less prone because of her sex to all of the organic lesions of the brain and the spinal cord, but with sensibilities more acute, with capabilities of mental impressions so decided, she is infinitely more disposed to the manifold functional derangements of these organs, such as neuralgia, hysteria, chorea, neurasthenia, migraine, epilepsy, mania, melancholia, and eclampsia. The performance of the functions of her pelvic organs is too often painful. The frequent occurrence of dysmenorrhœa, purely or largely neurotic in type, is indicative of these inherited or acquired functional anomalies of her nervous system—a local expression of a general neurosis—as are also many of the symptoms of most pelvic diseases.

Women recuperate from disease or accident more readily than do men, bear the loss of blood better, are longer lived; notwithstanding this they are more acutely sensitive to pain.

A highly sensitive organization implies a special mobility of the nervous system, especially in its emotional nature. Its cell activity is easily disturbed, for it responds to every impression.

The presence and the severity of pain depend not so much on the disease as on a sensitive nervous system. Many of the minor ailments peculiar to the female sex can only be interpreted through the medium of an abnormally sensitive nervous organization. Many of the phenomena of most diseases with her are modified by the functions of ovulation and menstruation, gestation and lactation.

Pregnancy implies a somatic condition of fortification against the inroads of disease and injury; but the lying-in state after parturition means, as does also the menstrual period, a condition of body of special susceptibility to many diseases of an infectious nature.

More influenced, too, is she by fear, shock, excitement, and introspection; more easily made anxious and unhappy (mental pain), and more liable to disorders of the imagination and to suggestion.

How, now, are gynæcology and neurology correlated? Two features of the nervous system of woman in her hypersensitiveness must be apparent: first, a diminished resistance to the influences of morbid irritations; secondly, an increased tendency in frequency, in kind, and in force to reflex irritability.

Physiology has taught us how healthy organs of the female pelvis influence and modify the nervous system. How much more clear that pathological changes there located can do more. Any uterine or ovarian irritation may be transmitted by nerve-trunks already disturbed to organs of lessened resistance.

Great differences there are in patients in these particulars. Some reflexes are at times out of all proportion to local exciting causes. Without question, all of these functional neuroses are much more common among the educated and cultivated classes. In the charity hospitals of great cities, dealing with patients of the lower classes of society, these neuroses are comparatively unknown. Neurasthenia—the American disease—is a functional disorder of the nervous system characterized by an increased sensibility and a diminished resistance.

The method of mental education of the growing girl in our American life is in most instances a serious reflection on our intelligence and wisdom. Any system which in time, quantity, or kind is

carried on at the expense of the physical well-being is at fault. Girls need an education different from that of boys. There is a sex in body and in mind; so there should be in education.

We do many times the amount of mental labor of the last generation. Domestic and social life is ever being made more arduous and complex. American life, with its characteristic hurry and, what is worse, its worry, in its personal competition for gain and position, means an undue stimulation of, with its inordinate drain on, the vital forces. Hence breakdowns and nervous diseases, creating and modifying female pelvic diseases.

Any pronounced local disease may be incompetent to excite general disturbances if the body resistance is at par. But a slight local disorder in a depreciated condition of general health may lead to some aggravating, persistent nervous affection out of all proportion to the underlying basis. A transferred irritation shows itself at the most weak—the vulnerable—point. Few, if any, morbid states of the whole uterus demonstrate to a greater degree the varying susceptibility of the nervous system to pain and reflex irritations than does an extensive laceration of the cervix. No symptoms may be present; many and serious disturbances may follow. Almost all such local and reflex phenomena are relieved by the "change of life," provided malignant processes do not supervene. Repeated and prolonged local treatments aggravate all nervous symptoms, physical and psychical, in one of a highly sensitive and emotional nature, with poor general health.

Many catarrhal affections of the genital tract are symptomatic purely of a waste of nutrition and a nerve exhaustion. To assert that a pelvic disease associated with a neurasthenia is the foundation of all of its symptoms, and that its cure will relieve the nervous perturbations, is a grave error.

Few constitutional diseases or local affections of distant organs of the body exist that we do not find in women some peculiar expression of the same in her sexual system. Again, no disease or class of diseases in the female economy sets up more decided disturbances at large than those of the female pelvic organs. In the brain there are observed sleeplessness and melancholia; in the general nervous system, paralyses, epilepsy, catalepsy, chorea, and vasomotor changes; in the larynx, aphonia; in the heart, irregular actions; in the lungs, cough and dyspnœa; in the stomach, nausea, vomiting,

indigestion; in the intestines, tympanites and diarrhœa; in the kidneys, alterations of the urinary secretion in quantity or quality; in the skin, acne, eczema, chloasma; in the mammary glands, diminished and altered lacteal secretion, pain, and localized indurations; in the joints, painful locomotion and false ankyloses, etc.

No local manifestation is constantly present; symptoms are varied in character and place. The nerve-cells undergo changes in nutrition, and often acquire an excitability which appears the very essence of the disease. Any treatment addressed purely to these symptoms is unsatisfactory. The nausea and vomiting of pregnancy, the eclampsia of parturition, are largely reflexes, most noticeable in neurotics. Versions and flexions of the uterus are clear instances of pelvic disease exciting reflexes. Quick abatement of the hystero-neurosis epilepsy has often followed the removal of diseased ovaries. The most common cause of hysteria and neurasthenia in women is pelvic pain. The local pelvic condition ought to be investigated in all cases of these diseases before treatment is formulated. A dysmenorrhœa due to some local uterine mischief may be sufficient to unbalance a defective nervous system. How often is the most rational explanation of a vesical or rectal irritation referred to some chronic metritic or perimetritic disease. Oculists are forced by exclusion to point to the pelvic organs as causative of the visual disorder of some cases.

Puerperal insanity, while not distinctly reflex, is due to some strain of reproduction, parturition, or lactation in neurotic subjects. But twenty-five per cent. of insane women have any gynæcological disease. No amount of pelvic or general physical disease will cause a psychosis unless conditions favorable thereto exist in the brain or the nervous system. All insanities have nervous exhaustion and depression and some irritation as inherent factors. Their presence indicates a lowered vitality, a nervous strain, or a toxæmia which the nervous system is unable to withstand. Mental aberrations are more frequently functional or reflex in women than in men, hence more frequently recovered from. A mental depression is often noticed in healthy women at the menstrual epoch; therefore most cases of insanity, reflex or otherwise, are worse at the catamenial periods. Insanity and female pelvic diseases do at times have a well-defined relation of cause and effect.

Insanity has been promptly relieved by gynæcological opera-

tions; and it has immediately followed them. The reason must be apparent when we recognize the long-continued and general impairment of health,—the preceding illness,—as well as the shock of the operation. The last, it may be, was the straw to snap the mental sanity. Operations on the genital organs are attended by a greater predisposition to insanity than other surgical procedures. Most post-operative insanities are quickly recovered from, but are most likely to occur in those previously deranged. No surgical procedure is to be considered for insane women unless warranted on the sane. None should be neglected in cases of insanity, whether for causative lesions or not, if bodily comfort of and diminished care for such are reasonably assured. An exact understanding of all pelvic conditions of insane women should be obtained early in their management and in the presence of one or more witnesses.

The sexual organs are thus the prominent links in the chain of a woman's mental and bodily health. The pelvic organs quite generally express and become good indicators of a woman's health.

Some of the more gross female pelvic diseases do not give rise to any special reflex disturbances. Thus, an ovarian tumor, cystic or solid, or a uterine fibroid,—it matters not how large,—is generally unattended with any resulting nervous phenomena. Most symptoms present are consequent on a depreciation of the general health or on pressure on the surrounding parts or organs. Cancer of the uterus has no reflexes. Who has not observed the most marked forms of uterine displacements without symptoms? But not so with all uterine displacements. None is more active as a direct exciting cause of irritation than retroversion with retroflexion, especially if the uterus is fixed in its faulty position by peritoneal adhesions.

Many authorities would lead us to believe that the ovaries are responsible for more reflexes than is the uterus. Tilt, Hegar, and Schroeder have so expressed themselves. Others contend that more reflexes are referable to the uterus. De Sinety distinctly states that many post-mortem examinations of hysterical women who had pelvic hyperæsthesia failed to reveal any ovarian inflammation. Skene, on the other hand, says he has seen more marked derangement of the brain and nervous system from chronic ovaritis than from disease of any other pelvic organ. It is the personal observation of the writer that chronic perimetric inflammations,—inflammatory exu-

dates on and about the Fallopian tubes and ovaries,—old cases of septic and specific salpingitis and ovaritis, with localized pelvic peritonitis, do the most mischief both directly and indirectly. When we consider the rich supply of blood and the abundant distribution of nerves and ganglia in this region, their free anastomosis with the peripheral and central nervous centres, and how closely these filaments become nipped in cicatricial formations, how easily they may become disturbed by pressure and traction, it seems reasonable to assume such a position.

We should be exceedingly chary not to make castrate neurotics.

It is desirable, above all things, to determine with scientific accuracy the proper relation of neurological and gynæcological affections. One of the growing evils of to-day is the mistaking of a nerve disease for a womb disease. The knife is too much the emblem of gynæcological treatment. A recovery from an operation is not a recovery from the disease for which the operation is done. Excessive sensibility, with a lack of will-power and a depreciation of general health, means a disease essentially neurotic.

All of the functional neuroses are intimately correlated, but there is no direct relationship between these neuroses of women and their pelvic conditions. These neuroses cause functional—possibly structural—disorders of the pelvis because of some impairment of the general health, diminishing thereby physical resistances and increasing susceptibilities to the reflexes, and *vice versa*. Either may exist independently; when associated, their relationship is always more or less indirect.

UNCONTROLLABLE VOMITING OF PREGNANCY.

CLINICAL LECTURE DELIVERED AT THE CHARITÉ HOSPITAL, PARIS.

BY A. BOISSARD, M.D.,
Accoucheur to the Paris Hospitals.

GENTLEMEN,—We have recently had in our wards, as you are aware, a case of uncontrollable vomiting during pregnancy, and I propose to take advantage of this occurrence to examine all patients with this affection that have been treated by me, and to try to clear up this question which is so obscure on many points.

The pathogeny of this severe form of vomiting is still shrouded in mystery. Vomiting is so common during pregnancy that to a certain extent we rely on it as a symptom of that condition, of which it forms a fairly reliable indication. Although in the majority of cases the vomiting affects nutrition little or not at all, in others, which are fortunately rare, it produces such a state of exhaustion that women are even in danger of dying from it.

The gravity of vomiting during pregnancy does not depend altogether on its intensity, frequency, or recurrence; there seems to be another factor in the question, another element that hastens denutrition and produces physical exhaustion of the whole body. You will see, for instance, pregnant women vomiting after each meal, and appearing to vomit the entire meal, and still their nutrition will not be seriously affected. In these women assimilation of food continues, their skin retains its color, and their loss in bodily weight is insignificant. It would seem that such women only throw off what is unnecessary for their nutrition. As a rule, patients of this class vomit only after meals; or, if they do vomit at the beginning of a meal, they can come back to the table and eat and retain the meal.

But with women who, on the other hand, are affected with the uncontrollable form of vomiting during pregnancy, not only is the digestive function perverted or abolished, but their nutrition is

very quickly affected, and affected very seriously: the skin becomes waxy, dry, and scaly, and the epidermis cracks through rapid mortification. The skin is the first tissue that appears to be affected in function and nutrition; its superficial layers and the nails are the first to show signs of trophic alterations.

Since 1891 I have met with six cases of uncontrollable vomiting, three occurring in primiparæ and three in multiparæ; of these six women, one, a multipara, died. I saw her in consultation with her physician, and we decided that before having recourse to abortion we would wait and try simpler means. The electric treatment was applied with all the skill that could be desired and according to the rules recommended for such cases, but without result, and it was abandoned at the end of five days; then when the question of emptying the uterus artificially again came up, the patient died suddenly, within twenty-four hours, in a subdelirious condition.

From the cases it has been my lot to see I think that uncontrollable vomiting in primiparæ appears nearer the beginning of pregnancy—in the second and third months—than with multiparæ, in whom the vomiting may become uncontrollable only in the fourth month. There are special and differential features between the early uncontrollable vomiting of primiparæ and the later form of multiparæ, and I propose to arrange these in two categories, in order to draw some inferences as regards the pathogeny of uncontrollable vomiting.

As regards the character, strictly speaking, of the vomiting,—that is to say, its abundance, repetition, and frequency,—I have noted nothing peculiar unless it be that with a primipara, when the vomiting is likely to turn into the uncontrollable form, the symptoms become much more rapidly serious than with a multipara, who appears to have greater power of resistance.

In cases of uncontrollable vomiting, both with primiparæ and multiparæ, not only does the rejection of food immediately follow the taking of a spoonful of liquid, but there is a permanent condition of nausea, and at a certain stage these patients make continual efforts to vomit. They then vomit with an entirely empty stomach, which can be done only at the cost of extremely distressing and painful contractions.

Besides the twofold difference as regards the method of occurrence of uncontrollable vomiting in primiparæ and multiparæ,

concerning the moment at which it appears, and the rapidity with which it becomes serious, it seems to me that pregnant women in this condition can be divided into two classes according to the differential state of the tongue, the urine, and the pulse.

These differences, which I have observed in both classes of women suffering from uncontrollable vomiting, appear in various cases that are equally seriously affected. I therefore think that no prognostic value can be attached to them; in other words, that these differences in the tongue, urine, and pulse cannot be used as a basis in forming an opinion as to the ultimate course of the disorder, or as to the treatment that the case will require.

Thus, there is one class of pregnant women, usually primiparæ (it must not be lost sight of that these cases are, after all, *rare*), in whom vomiting appears early, and in whom to the end the tongue remains moist, with little or no coating, and without foul breath. In these women the amount of urine passed daily may be reduced to a few cubic centimetres in the twenty-four hours, and yet show no albumen. In this same class of women the pulse up to the end is thin and weak, sometimes intermittent; but the pulsations range between 80 and 90. It is with a purpose that I say "to the end;" not that I agree with some of my colleagues that in such cases the course of pregnancy must be interrupted, but because these patients had reached the limit of safety. One of them, for instance, in forty days decreased in weight from one hundred and twenty-one pounds to ninety-four and a half pounds, a loss of twenty-six and a half pounds; yet the tongue was not dry, the breath was not fetid, the scanty urine contained no albumen, and the feeble pulse ranged between 84 and 94. Patients of this class present in the highest degree the stigmata of hysteria or of pronounced neurasthenia, and their hereditary antecedents are very bad in that respect also.

In the second class of pregnant women suffering from uncontrollable vomiting the picture is directly the reverse: the tongue becomes dry and the lips crusted, while the breath is so foul that it is difficult for other persons to remain in the room; the urine, which is scanty, contains albumen; usually not very great; and the pulse is thready but rapid, ranging from 120 to 130, and even 140. There are also bulbar symptoms and the pupils are affected.

With symptoms as different as these, which yet in both cases may end fatally, it appears to me necessary to admit that there

are two causes, two special states, that may produce uncontrollable vomiting in pregnant women, who, in this respect, should be divided into two categories: hysterical patients and those who are auto-intoxicated. This is probably the reason why the uncontrollable vomiting which appears in patients of the first category does so at the beginning of pregnancy, and with primiparæ, whose hereditary antecedents of a neuropathic nature are very extensive. Whether or not there is an exaggerated reflex from the uterine organs, there is in any case a general revolt of the system, including possibly in some cases a revolt of the mind towards the incipient pregnancy. In some instances there is even an actual pathological condition of the nervous system, with screams, hallucinations, or delirious ideas.

If my idea is accepted, that there are two forms of uncontrollable vomiting, with a special set of symptoms for each one of them, the efficacy or inefficacy of our remedial agents will be understood, according to whether we have to deal with the one form or the other,—that is, whether the case is a manifestation of hysteria or of auto-intoxication.

It must nevertheless be understood that whichever the form may be in our patients, a fatal ending may occur in both classes: death occurs through inanition, with the set of symptoms produced by continuous and rapid denutrition. It remains to be shown whether the duration of the disorder is different in the two instances, and whether the final phenomena are identical in both. It is possible that further research concerning the respective degree of toxicity of the serum and urine may throw light on this point and furnish us with the information lacking.

The question next arises whether the description given by Dubois in 1852 of uncontrollable vomiting must be considered exact and complete at the present day. I do not think so; and I feel that his division of the disorder into three periods is artificial rather than clinical. Is there a symptom or group of symptoms that enables us to know where the first period ends and the second begins, or the second ends and the third begins; or, from a therapeutic point of view, is there a single symptom that shows us that we must intervene at a given moment or lose the patient? How do we know when we bring on an abortion in a case of uncontrollable vomiting that we are not acting too hurriedly, or that if we put it

off till to-morrow we shall not act too late? To any one who feels the weight of his responsibility there are moments of anxiety when it is extremely difficult to perceive what is his true professional duty.

In my opinion, neither the frequency nor the smallness of the pulse has any absolute value as regards the indication of performing abortion, as I have seen serious cases in which the pulse did not go up to 100; such cases occur in early pregnancy, when the vomiting is connected with an hysterical condition.

On the contrary, a scanty urinary secretion and continuous loss of weight are of the greatest importance, whatever may be the form in question or the category of women suffering from uncontrollable vomiting.

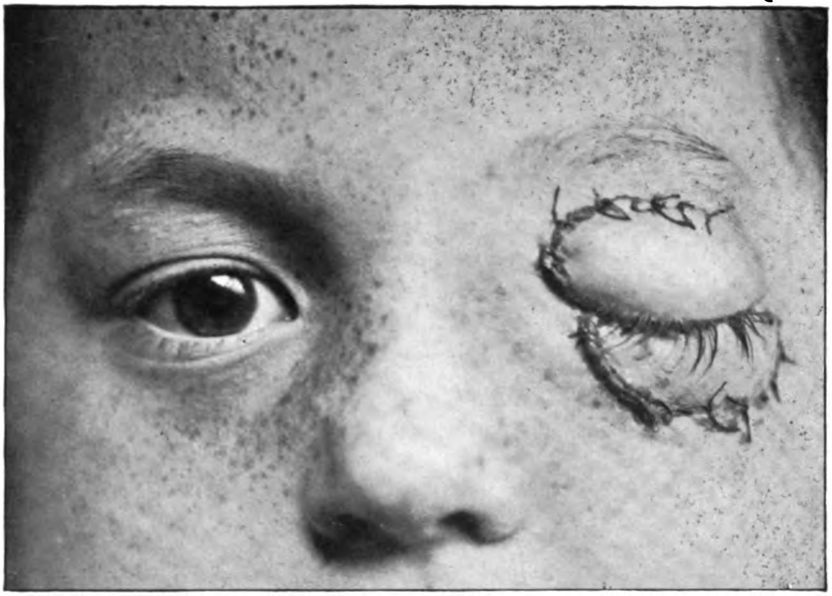
Unfortunately, in our city practice it is difficult to have our patients weighed, which is a matter of vital importance. Furthermore, in the immense majority of cases the obstetrician is called on only when the usual therapeutic means have failed, when the vomiting has become uncontrollable, and when the loss of weight is considerable; in a word, he is sent for only to have the serious case turned over to him, and to be called on to take a step that is a matter of grave importance and to assume its entire responsibility. Under these conditions it is often difficult to have the patient weighed, as time presses; besides, we should not be warranted in basing our line of action exclusively on the daily loss in body weight. Everything depends on the former condition of the patient's health and on her staying power. It is unquestionable that women of slight physique, who have not much to fall back on, will resist for a shorter time than will those whose health was robust before they became pregnant. Certain women, for instance, when they have lost from eight to ten ounces in weight per diem for a month have exhausted their resources, whereas others can still go on for a long period.

Nevertheless, this daily loss in body weight is, after all, the best guide in deciding upon the line of conduct you should adopt; and I am of opinion that when nutrition suffers rapidly and steadily in spite of the judicious use of the various therapeutic remedies at your disposal, the question of producing premature delivery must be considered.

In this respect I think that unless your hand is actually forced

you will be wise to adopt the gentler methods of inducing the expulsion of the contents of the uterus in preference to the more energetic ones, which may have the advantage of being rapid, but which necessarily, by always giving rise to a considerable loss of blood, and by producing a condition of shock, bring on in these women, who have a tendency to fall into syncope at the slightest movement or emotion, a state that may become quickly fatal, in spite of the injections of serum, which you should always use in such cases.

The milder methods may be slow, and the expulsion may take from one to ten days; but you must know that the mere death of the product of conception produces, if not complete cessation, at least decrease in the vomiting. In one of my cases the patient was able, six hours after a catheter had been inserted into the cavity of the uterus, to retain half a glass of milk, and began to take solid nourishment before the expulsion occurred. It is such facts as these that led to the method of dilating the external os of the cervix; but digital dilatation in a primipara of two or three months is impossible. If, therefore, you prefer to use this method, you had better use a tent of laminaria, the introduction of which *may* not be followed by abortion. If you are not in a great hurry, you might try this process, which leaves a *slight* chance of the pregnancy continuing, and gives you the satisfaction of feeling that everything has been done to conserve the interests of both mother and child; but if the mother is in danger, the child must be sacrificed.



Case I.—Fig. 1.—Laceration of upper and lower eyelids, produced by the horn of a cow. Appearance of the lids after the insertion of sutures.

Case I.—Fig. 2.—One year after the operation.

Diseases of the Eye and Ear

INJURIES OF THE EYELIDS AND EYEBALLS.

CLINICAL LECTURE DELIVERED TO THE SENIOR CLASS OF THE MEDICO-CHIRURGICAL COLLEGE, PHILADELPHIA.

BY L. WEBSTER FOX, A.M., M.D.,
Professor of Ophthalmology in the Medico-Chirurgical College, Philadelphia, Pa.

GENTLEMEN,—I shall present to-day a series of cases of injuries to the eyelids and eyeballs, as a knowledge of their treatment will be most valuable to you in general practice. Injuries of all descriptions should be very carefully examined when first seen, to ascertain their extent and character. In incised, lacerated, or contused wounds the ordinary principles of treatment are applicable; but in the first two great care must be exercised in uniting the edges of the wounds and in saving every particle of tissue. The loss of normal tissue is to a certain extent supplemented by the formation of cicatricial tissue, but this in time undergoes retraction and causes more or less disfigurement, particularly in cuts or burns of the eyelids.

In treating wounds of the eyelids, whether the lid is partially or completely severed, accurate union can scarcely be accomplished by means of adhesive plaster. It is better to suture the parts by stitches three lines apart, using small, delicate needles with a single thread. The important point is that the edges of the tissue should be brought in direct apposition to each other, and that they should be held securely in place, the whole being dressed with an antiphlogistic lotion.

CASE I. *Extensive Laceration of the Upper and Lower Eyelids, produced by the Horn of a Cow.*—This little girl, who comes from Dauphin County, was hunting eggs, and while crawling beneath a

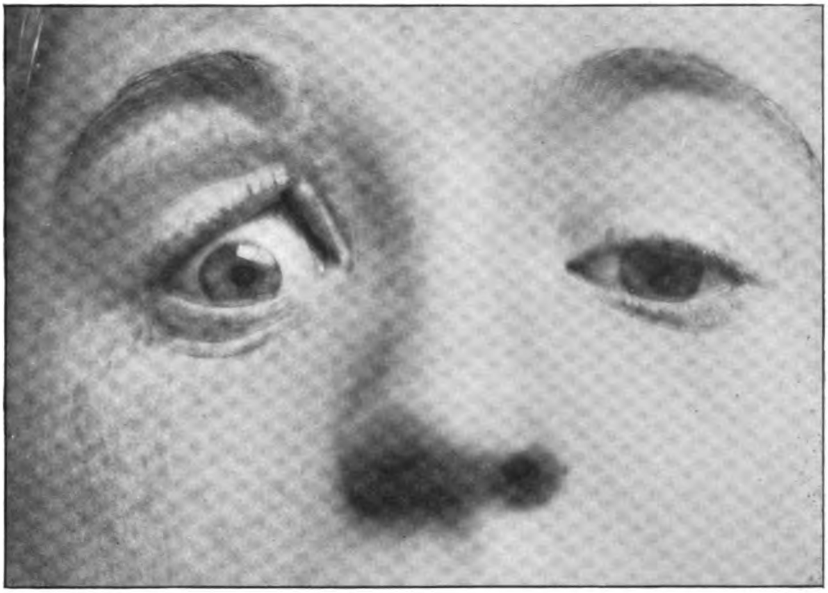
trough in a stable startled a cow, which made a plunge at her, lacerating the upper and lower eyelids with a horn. I found the upper lid torn away from the inner to the outer canthus, attached only by a pedicle to the temple. The lower lid was torn in the same manner, but not quite so extensively. Dr. Bashore, who was called to see the child immediately after the injury, applied cold mercuric chloride solutions until I could see the patient at the hospital, twenty-four hours later. I stitched the torn edges of the partially swollen eyelids together and kept them covered with antiphlogistic applications.

Strange as it may seem, the eyeball escaped injury. The horn evidently struck the superior maxillary bone and glanced upward, detaching the lower lid, hooking under the upper lid and tearing it off completely, producing the most extensive wound of the eyelids I have ever seen. The complication which is likely to arise in this case is that, after healing has taken place, ptosis will follow, owing to the extensive laceration of the upper lid. There is bound to be a partition of cicatricial tissue between the eyelid and the brow; the fibres of the levator palpebræ muscle are severed, and in consequence ptosis will follow. Later on, an operation can be performed to raise the eyelid.

Case II. *Laceration of the Upper Eyelid, caused by falling on a Broken Bottle.*—At the age of three the patient fell upon a broken bottle, the sharp edge of which cut through the upper lid. This was followed by disfigurement, which is becoming more pronounced as the woman grows older. The retraction of the lid has caused exposure of the cornea, in consequence of which vision has become impaired. I propose to trim the cicatricial margins of the coloboma, bring the ciliary margins of the lid together, and insert a superficial skin graft, my purpose being to replace cicatricial tissue with normal tissue and to give a better shape to the deformed eyelid. I shall take the skin graft from the patient's arm, using Thiersch's method.

The technique of the operation is simple, the most important detail being the separation of the band of cicatricial tissue which holds the eyelid to the brow and which prevents closure of the eyelids.

Case III. *Burn of the Face; Cicatricial Contraction; Ectropion of the Eyelids.*—This young woman was very severely burned



CASE II.—FIG. 3.—Cicatricial retraction of upper eyelid following a wound caused by falling upon a broken bottle.

CASE II.—FIG. 4.—After operation, with extreme elevation of eyebrow.

CASE II.—FIG. 5.—After operation—eyebrow in normal position.

CASE III.—FIG. 7.—Ectropion of lower lid due to a burn. Thiersch graft made on upper lid two years previously.

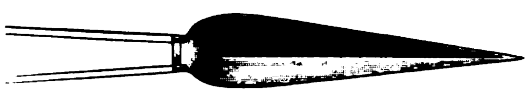
on the face. The amount of cicatrization shows that the burn must have been extensive. In time the cicatricial contraction became pronounced. An attempt was made to remove part of the cicatricial tissue and replace it by the pedicle method of skin-grafting. A large flap was dissected from the arm, which was brought over the cheek and fixed to the patient's head; the flap was then stitched to the cheek, the pedicle nourishing the flap. The operation, however, was not an entire success. Two years ago the retraction of the upper eyelid led me to insert a Thiersch's graft, the white outline of which is distinctly visible. The result in this case was most gratifying, the general retraction of the upper eyelid was relieved, and closure of the lid is now possible.

The patient comes to-day on account of the ectropion of the lower lid, which is slowly growing worse, exposing the lower margin of the cornea and causing keratitis and a protrusion of the conjunctiva, which are both disfiguring and repulsive.

The first step in the operation I shall perform is to make a deep incision through the skin along the ciliary margin of the eyelid. The lower lid is then stitched fast to the upper lid by four sutures. This draws the lower lid upward and away from the cicatricial tissue that bound it to the cheek, leaving a raw surface measuring about two and one-half centimetres along the lid margin and one and one-half centimetres at its greatest width. This raw surface must now be covered with a skin graft. It is very difficult to cut off a large flap with the means usually employed, such as a razor, etc., so the method adopted to-day will be different from Thiersch's. The graft is first outlined with a Beer knife, cutting through the skin.

You notice that I make the graft at least one-third larger than the raw surface which I wish to cover. Under ordinary circumstances I would have great difficulty in dissecting off a piece of

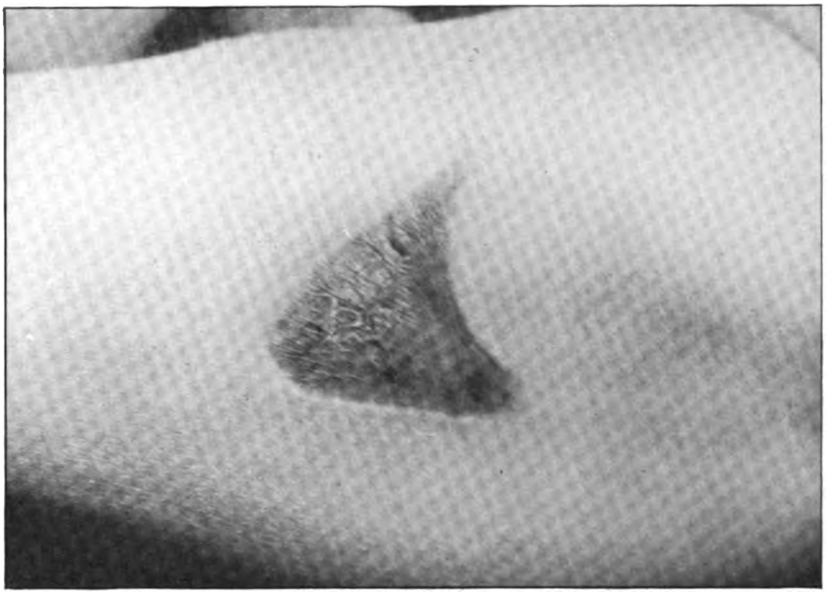
FIG. 6.



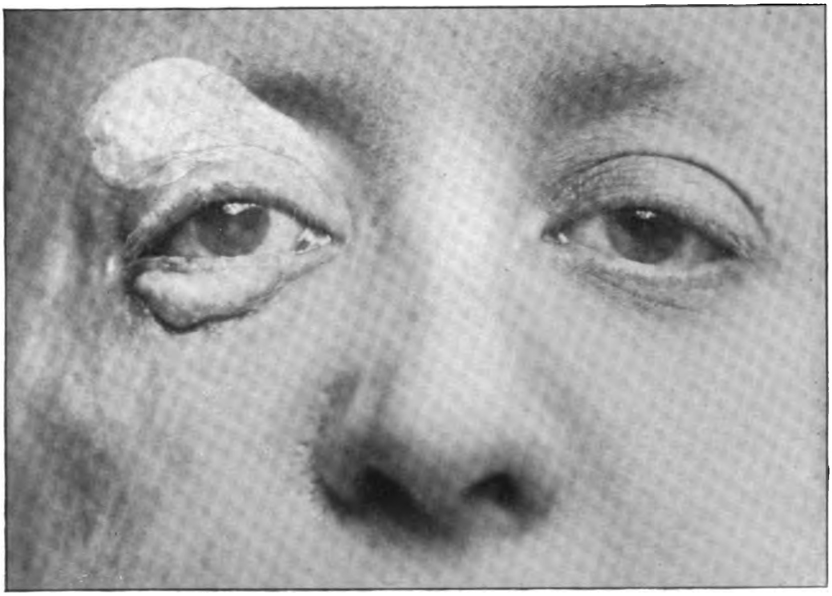
skin large enough to cover a wound of this size. Having outlined the graft as to size and shape with a Beer knife, I take this spear-

shaped blade (made after the Baron Wentzel cataract knife), pass it under the skin in the middle line of the flap, and by a gentle sawing motion easily cut through the tissue, leaving a small outer attachment to keep the graft taut; the blade is then reversed and the inner section is cut through in the same way; this is the simplest method of cutting off large pieces of skin. The graft is immediately transferred to the raw surface underneath the eyelid. I first stitch it to the ciliary margin of the lid and then anchor the graft here and there on the cheek, covering it with bismuth formic iodide comp. powder, and a bandage. The patient is put to bed and the dressings are not disturbed for forty-eight hours. The bandage is then carefully removed and adhering cotton is washed away by warm saline or boric acid solution; the wound is redressed and not disturbed for forty-eight hours. At the end of that time the stitches are taken out. It is not always necessary to use stitches for a graft of this kind; but by employing them the graft is kept closer to the margin of the lid. Fig. 7 shows the appearance of the graft six weeks after the operation.

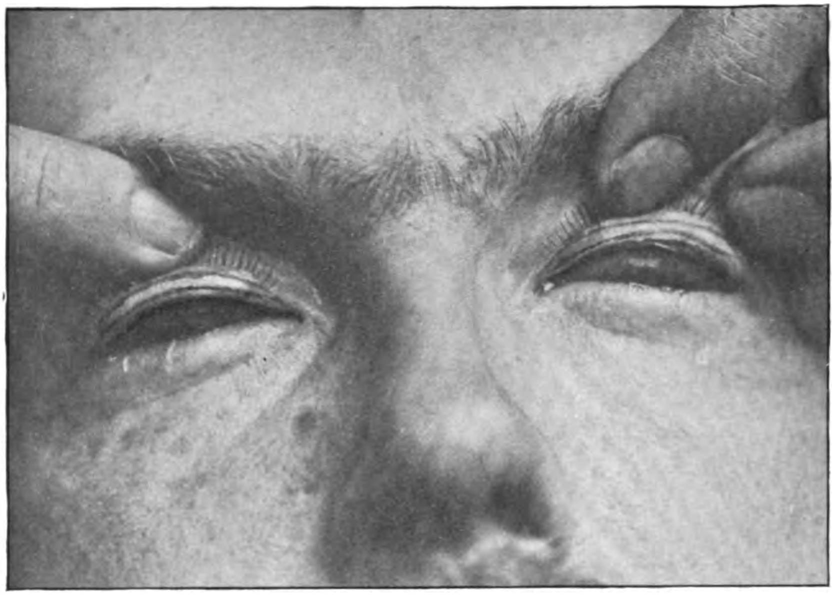
CASE IV. *Trichiasis following Granular Lids.*—This belongs to a series of cases in which skin is transplanted from one part of the body to another. I always give preference to a Burow operation, that is, splitting the cartilage from the inner to the outer canthus. This operation yields good results in the majority of cases, but in some it does not cause sufficient eversion of the lashes from the eyeball; in such cases I split the tarsal margin of the eyelid, just behind the ciliary border, to a depth of three lines from the inner to the outer canthus. I then take a narrow wedge-shaped strip of skin (the skin surface forming the base) of sufficient length to fit into the lid margin. This I insert with a small spatula after the bleeding from the lid wound has stopped, as otherwise the hemorrhage would wash away the graft. It is interesting to note how easily this graft is inserted and how tenaciously it holds in place. The graft is taken from behind the ear, as there seems to be no shrinkage of the skin removed from this region when transplanted. If the skin back of the ear should be covered with very fine hairs, it must not be transplanted, because these hairs will grow and irritate the eyeball. I in one instance was obliged to dissect out the implanted tissue for this reason. A thin strip of mucous membrane may be used instead of the skin graft. We are



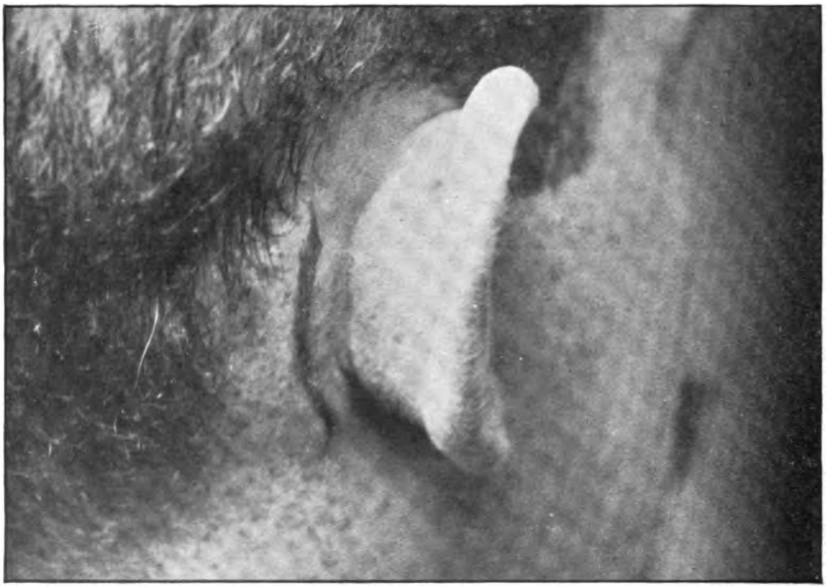
CASE III.—FIG. 8.—Graft taken from arm.



CASE III.—FIG. 9.—Skin-graft of lower lid six weeks after the operation.
(Incorrectly referred to on page 208 as Fig. 7.)



Case IV.—Fig. 10.—Wedge-shaped strips of skin inserted in lid margins in the operation for trichiasis.



Case IV.—Fig. 11.—Region behind the ear from which the graft was taken.

indebted to Dr. Hotz, of Chicago, for this operation, and I recommend it most highly in pronounced cases of entropion.

The case before you was operated upon four weeks ago, and the result is very good. The eyelashes are retained, and now turn from the eyeball, protecting the cornea instead of provoking an irritation, as was formerly the case, which would eventually cause pannus, etc.

CASE V.—This patient placed a torpedo on a railroad track and standing on a platform, ten feet above, threw a two-pound weight on the torpedo thus placed. When the explosion occurred this piece of tin, which I show you, flew up, striking his upper eyelid, cutting it diagonally from the outer to the inner canthus, making a wound one inch long, and splitting the eyelid so that the conjunctiva of the upper eyelid hung down in a large fold. The eyeball was cut into vertically and its contents evacuated. The torpedo also cut the lower lid below the ciliary margin, penetrating deeply in the bone. The mutilated eyeball was removed and the lacerated conjunctiva of the upper eyelid was stitched into place. The orbital cavity healed by first intention, and the present condition shows good coaptation; the orbital cavity is deep; cicatricial tissue has replaced the detached lid on the nasal side; the orbicularis muscle acts promptly and there is good movement of the eyelid. An artificial eye may be worn with fair degree of comfort.

It is my intention to fill out the coloboma made by the wound by resorting to skin-grafting. This case is one in which the implantation of a gold or a glass ball will aid materially in correcting the enophthalmos of the artificial eye.

BURNS OF THE CORNEA.

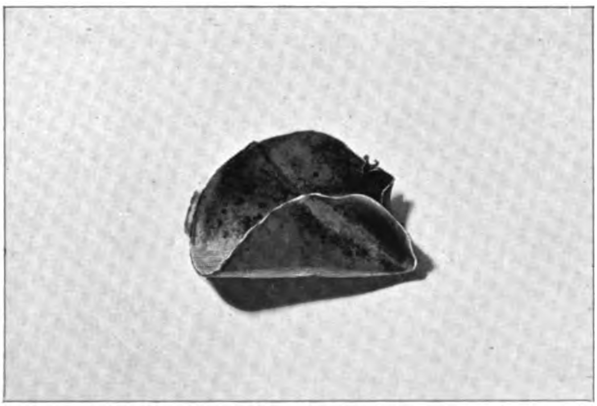
The explosion of various gases causes the highest percentage of losses of vision, by either completely or partially destroying the eyeball. Gunpowder explosions probably rank first in the list. Boys, on the Fourth of July, through excitement, grow careless, and as a result faces are scorched and eyes are burned. I recall an instance in which several boys were discharging a toy cannon. It hung fire, and one of the lads went to the cannon and blew into the touch-hole; the result was an explosion. I was called to see the case, and made an examination shortly after the accident.

Upon elevating the eyelids I found that both eyes were more or less sprinkled with grains of powder and that the conjunctiva was considerably burned. In another case several boys were making and exploding mines. The fuse hanging fire, one of them blew on it, and almost instantly earth was thrown in every direction, some of the dirt flying into the boy's eyes, causing serious impairment of his vision. I have had under my care several accidents caused by recklessly exploding "alarm cartridges." Gunpowder explosions constitute only one of the many causes of accidents to the eyes which may come under your observation and demand your skill; among these may be mentioned boiling water, mortar, melted fat, acids (especially sulphuric acid), caustic potash, explosions from kerosene-lamps or from gas, etc. In some of these accidents the cornea escapes and the conjunctiva only is injured. When the cornea is touched by a gas-flame, hot iron, or melted lead, the epithelium of the cornea undergoes coagulation like a layer of albumen, turns white, and is raised like a blister. The part of the eye thus affected always desquamates. If the burn has extended into the deeper layers of the cornea, very serious complications, tedious ulcerations, even perforation of the cornea, may ensue. Staphyloma sometimes develops and vision ultimately is lost. The amount of heat the eye can stand is marvellous. A hot furnace may be approached without injury to the eye, while the other parts of the face will be scorched.

In gunpowder burns of the face and eyes do not pick off the grains of powder from the cornea with a spud; the trouble is aggravated by irritating the already damaged cornea in this way. Wash the face freely with hot water. The water that enters between the lids will dissolve the grains of powder and cleanse the parts thoroughly. When examining the cornea keep the lids apart by using the speculum and irrigate the eyeballs with an eye-douche. While the eye is rotating gently try to remove the powder grains with a small pledget of cotton; this is the best means of removing foreign bodies of any kind from the cornea.

Hard substances, like emery or grains of sand, which have become imbedded in the tissues should be removed with a spud, after which liberally irrigate with water or a boric acid solution. After this treatment the eye requires rest; this is best secured by using atropine (one grain to three drachms), to prevent possible disturb-

CASE V.—FIG. 12.—Wound of eyeball and lids caused by the explosion of a torpedo.



CASE V.—FIG. 13.—Fragment of tin driven into the eye by the explosion.

CASE V.—FIG. 14.—Appearance of the orbital cavity after enucleation and the reposition of the conjunctiva and the lacerated lids.

ance of the iris and ciliary body. Bandage both eyes with sterilized vaseline and eye-pads. This treatment should be repeated at the end of twenty-four hours. When the cornea is hazy, instillations of eserine (one-quarter of a grain to three drachms) will aid in its preservation. For burns by alkalies apply melted tallow, any oil, unsalted butter, vinegar, molasses, or sugar. These remedies are always at hand. It is well to resort to a dark room and to keep light from reaching the eye. Every case is a law unto itself, and careful attention must be given each case. Be very guarded as to the prognosis of all injuries, especially in the case of burns, for they are treacherous. A cornea immediately after the accident may show little or no morbid change, yet in three days may undergo complete exfoliation.

Laboratory Methods

THE USE AND CARE OF THE MICROSCOPE.

BY WILLIAM C. KRAUSS, M.D., F.R.M.S.,
President of the American Microscopical Society.

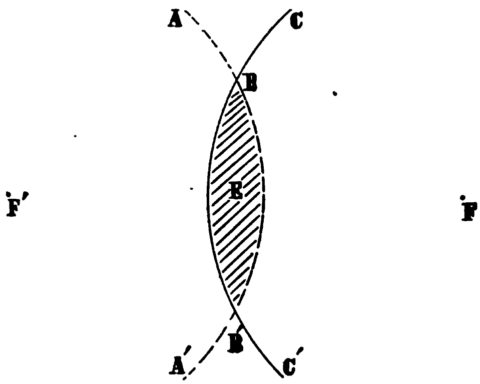
THE convex lens has attained great importance in practical optics, its magnifying properties rendering it of inestimable value in the manufacture of optical instruments. It forms the basis of the microscope, the camera, and the stereopticon in the magnification of near objects, and of the telescope, the field glass, and allied instruments in magnifying distant objects and bringing them nearer the observer.

A convex lens is usually a piece of crown or flint glass which represents a part of a solid of revolution, and may be double convex, plano-convex, or concavo-convex. These three forms are also called converging lenses, because rays of light passing through them converge to a point beyond the lens, the distance of this point from the lens depending upon the degree of its curvature or convexity, and the quality of glass composing it.

Fig. 1 represents a transsection of two intersecting spheres having their axes at F and F′. The area B B′ formed by the intersection of the spheres A A′ and C C′ represents a double convex lens, with axes at F and F′ respectively. A line drawn from F to F′ intersecting the lens would pass through E, the centre of the lens and the part of this line F E F′ which would traverse the lens is designated the principal optical axis. All other lines passing through E, the optical centre, are designated secondary axes. Every ray of light whose direction on emergence is parallel to its direction before entering the lens must pass through the point E, in traversing the lens; and conversely, the direction of every emergent ray which in its course through the lens traverses the point

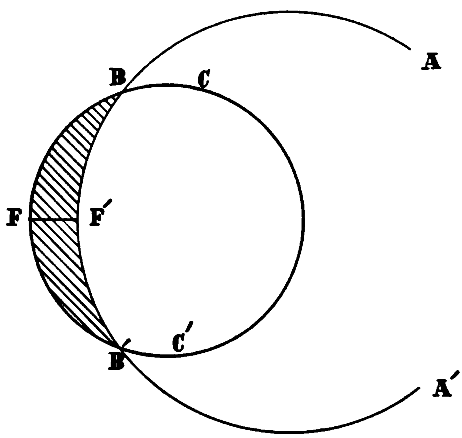
E is parallel to its direction at incidence. The point E, which possesses this remarkable property, is called the optical centre of the lens, and lies within it, its distance from the two surfaces being directly as their radii.

FIG. 1.



A plane passing from B to B′(Fig. 1) would divide the lens into two equal parts, one surface being plane, the other convex, forming two plano-convex lenses. The optical centres of these lenses would lie on their convex surfaces.

FIG. 2.

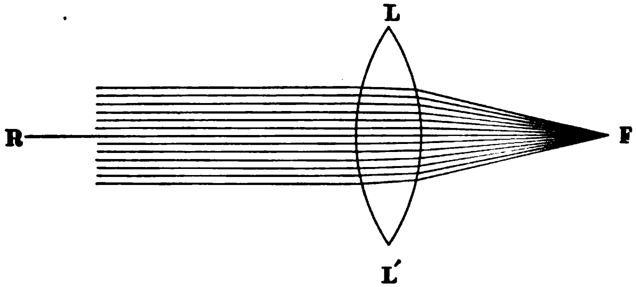


If two spheres, A A′ and B B′, one larger than the other, with their centres of curvature in close proximity to each other, intersect (Fig. 2), a segment, B B′, would be obtained, one side concave,

B F′ B′, the other convex B F B′, forming a concavo-convex lens, or converging meniscus. The line F F′ would be the optical axis, and the optical centre would lie outside the lens altogether, being situated on the side of the greater curvature, its distance from the surfaces being still in the direct ratio of their radii of curvature.

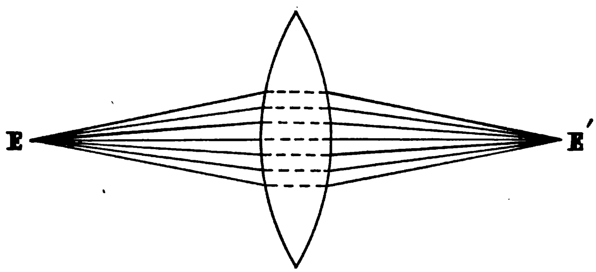
Rays of light originally parallel to the principal axis passing through a convex lens (Fig. 3) are refracted on entering and again

Fig. 3.



on leaving the lens, forming a convergent pencil, narrowing until it reaches a single point, F, which is called the principal focus, or focusing point of the lens. The distance between this point F and the lens L L′ is called the principal focal distance, or the focal length of the lens. One feature of a good microscopic lens, objective, is that it shall have a long focal length. The focal length depends on the convexity of the surfaces of the lens and the re-

Fig. 4.



fractive power of the material of which it is composed, being shortened either by an increase of refractive power or by a diminution of the radii of curvature of the faces (Deschanel).

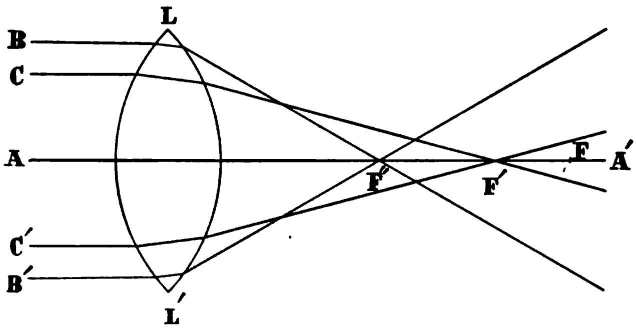
When a luminous point, E (Fig. 4), sends rays of light to a

double convex lens, the emergent rays, owing to the double refraction, converge to one point, E′; hence it follows that if the rays are sent from E′ they will converge approximately at E. These two points, E and E′, are called the conjugate foci, and the line joining them, E E′, must pass through the centre of the lens.

The passage of rays through a convex lens used for magnifying purposes is attended by two disturbing conditions,—namely, spherical and chromatic aberration. Rays of light passing through the circumferential portion of a lens are always more convergent and come to a focus sooner than those passing through the centre of the lens, and this deviation from exact concurrence is called spherical aberration. This produces curvature and distortion of the image, so that when it is clear around the edge it will be indistinct at the centre, and *vice versa*. This defect in a lens or a series of lenses, as in an ocular or objective, unless corrected by a diaphragm cutting off the circumferential rays or by a suitable combination of lenses renders it worthless for exact microscopical work.

In Fig. 5 let B C and B′ C′ be rays of light penetrating the

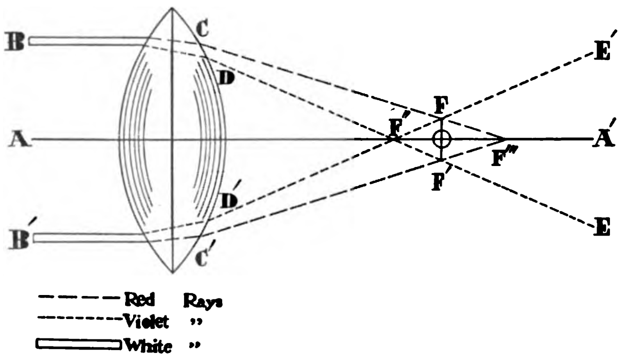
FIG. 5.



circumferential portion of the lens L L′, whose axis is A A′. The rays B B′ will come to a focus at F″, while the rays C C′ will focus at a somewhat further distance, F′, and the rays nearer the axis will be brought to a focus at F, the principal focus of the lens. To correct this difficulty a diaphragm shutting out the rays B B′ and C C′, or a combination of flint and crown glass, as in Fig. 6, will be necessary. A lens whose spherical aberration has been totally corrected is said to have a good flatness of field, one of the chief

characteristics of a good objective. The unequal refrangibility of the different elementary rays in passing through a lens is a matter of grave inconvenience to the microscopist. Other conditions being equal, the focal length of a lens depends upon its index of refraction, of the material of which it is made. This increases with refrangibility of the transmitted rays, the focal length being shortest for the most refrangible rays. As ordinary white light is made up of waves of varying length; the unequal refrangibility of the component rays causes a disturbing chromatic image in which the colors are superimposed; the violet rays, being short-waved or most refrangible, cross the axis first at a point somewhat nearer the lens than the principal focus, while the red rays, being long-waved or least refrangible, cross the axis last at a point farther from the lens than the principal focus.

FIG. 6.

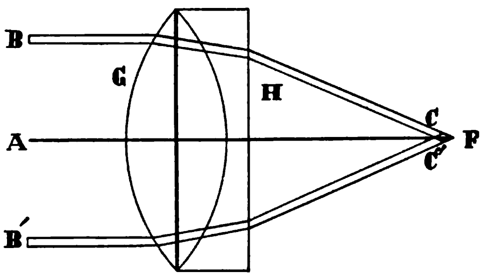


In Fig. 6 let B B′ be two rays of light directed towards the lens, whose principal axis is A A′ and principal focus at O. As the rays penetrate the lens they are divided into their component rays, the red being brought to a focus at F‴ beyond the principal focus O, while the violet rays come to a focus at F″, the intermediary rays will be brought to a focus between F″ and F‴, and as a result a superposition of colored images will be present, none of which is perfectly distinct. This source of confusion is called chromatic aberration, and is corrected by the use of varying glasses in the construction of lenses, as first devised by Hall, of Worcestershire, England, and later by Dollond, of London, who called their lenses achromatic. Dollond found that a concave lens of flint glass could

be combined with a convex lens of crown glass of double the curvature in such a manner that the dispersive powers of the two lenses would neutralize each other, being equal and acting in opposite directions.[1] But the crown glass having the greater refractive power, owing to its greater curvature, the rays would be brought to a focus without dispersion. Such is the principle of construction of the achromatic objective. As now made, the outer or crown glass lens is double convex; the inner or flint glass is generally nearly plano-concave.

Fig. 7 shows the construction of an achromatic lens or objective, G being the crown glass, double convex, and H, the flint glass,

Fig. 7.



plano-concave. The waves of light, B and B′, are no longer divided as they penetrate the combination lens and are brought to a focus at F, the principal focus of the lens.

Holding a double convex lens firmly by the thumb and forefinger, raising and lowering it until the object looked at becomes clear and distinct, one obtains a virtual image, erect, magnified, and at a greater distance from the lens than the object. This is the simplest form of magnification or amplification, and is the principle of the simple microscope. The object examined must, however, be brought within the principal focus of the lens.

Thus in Fig. 8 let the object A B be placed between the lens and its principal focus, F. Then the foci conjugate are virtual, and their position will be found at a b. The eye of the observer

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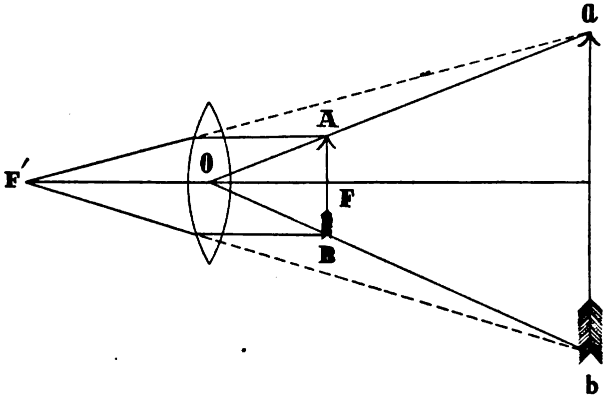
[1] By the refractive power of a glass is meant its power of bending the rays out of their course, so as to bring them to a focus.

By its dispersive power is meant its power of separating the colors so as to form a spectrum, or to produce chromatic aberration.

placed at F′ will see an enlarged, erect, and virtual image, a b, further removed from the lens than the object A B. This is the optical principle of the microscope ocular or eye-piece. The diam-

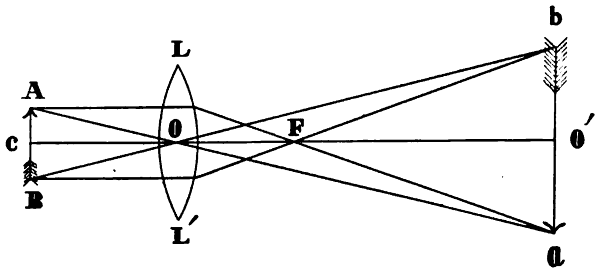
FIG. 8.



eters of the object and image are directly as their distance from the centre of the lens, and the image will be erect or inverted according as the object and image lie on the same side or opposite sides of this centre (Deschanel).

Let A B, Fig. 9, be an object in front of the lens L L′ at a distance less than the principal focus. The image can be found by construction as follows: From A and B draw lines parallel to the principal axis C O O′; they will be refracted by the lens and will

FIG. 9.



pass through the principal focus F. They will intersect the secondary axes B O and A O at a and b, the foci conjugate of A and B. The line a b is then the image of the line A B, and is an in-

verted, magnified, and real image. This is the optical principle of the microscope objective, and the stereopticon.

A real image differs from a virtual one in that the former can be projected on a screen. The rays producing a virtual image do not actually pass through its place, but only seem to do so.

Instead of a single convex lens, a system of such lenses may be used, mounted and supported to facilitate their use. In the common tripod magnifier a double system of lenses is employed, while in the achromatic pocket triplet a system of these lenses, one of crown and two of flint glass, is used.

The dissecting microscope consists of a double convex lens, mounted so that it can be easily manipulated, and the accessories adapted to the work which the microscope is intended to do. Simple microscopes have comparatively small amplifying power, and require the object to be brought nearer the lens than its principal focus. They are convenient to carry, easy to manipulate, of simple construction, and inexpensive. The objects to be examined possess considerable dimension and do not require any preparatory treatment.

The compound microscope differs from the simple microscope essentially in this,—that in the latter the rays of light which enter the eye of the observer proceed directly from the object itself after having been subjected only to a change in their course through the action of the simple lens; in the compound microscope, on the other hand, an enlarged image is magnified to the observer by another lens, as if he were viewing the object itself. In the compound microscope not less than *two* lenses must be employed; one to form the real enlarged and inverted image of the object over which it is placed, and hence called the object glass or objective, whilst the other lens again magnifies that image, and, being interposed between it and the eye of the observer, is called the eye glass or ocular.

While in the simple microscope magnification is the only essential requisite, in the compound microscope magnification without disclosure of detail, resolution, would be of no more scientific value than the projection of the photo-micrograph by an electric arc upon a screen (Carpenter).

Inasmuch as magnification combined with resolution is required of the compound microscope, it must possess a much finer

optical delicacy and a more intricate mechanical arrangement than the ordinary simple microscope as represented by the tripod magnifier or dissecting microscope. Minute or infinitesimal objects for examination must also be most carefully prepared and mounted.

A compound microscope is composed of, first, the essential parts; secondly, the complementary parts; and, thirdly, the accessory parts.

The essential parts consist of the optical apparatus proper, the lenses of the objective and the ocular. The complementary parts include the mechanism for the support and delicate manipulation of the lenses and of the object to be examined; in other words, the *microscope stand* with its draw-tube, body-tube, coarse and fine adjustments, mirror, and stage.

The accessory parts embrace the improved appliances which successive microscopists have devised for the more perfect adaptation of the instrument to modern scientific research; such as the substage, the mechanical stage, the iris diaphragm, the Abbe condenser, the nose-piece, the micrometer, and the camera lucida.

ESSENTIAL PARTS.

The Ocular.—The ocular, or eye-piece, is a lens or system of lenses whose object is to refract the divergent pencils of rays from the real object-image so that they may all reach the pupil of the observer's eye. It acts, moreover, like a simple microscope in magnifying the real image formed by the objective, to which it is antipodal. It therefore converts the real image formed by the objective into a virtual image.

Oculars are grouped into two divisions: the ordinary and the special. The ordinary eye-pieces are of two kinds: the positive and the negative. The latter are often called Huyghenian, having been designed by Huyghens for the telescope and afterwards adapted to the microscope. The special oculars include the micrometer eye-piece, the index eye-piece, the projection eye-piece, and the polarizing, the spectroscopic, and the binocular eye-pieces.

The positive eye-piece is the oldest of all, and was used with the early compound microscope. It consists of one system of biconvex eye lenses, without a field lens, and hence is sometimes

called the solid eye-piece. It may be used as a simple microscope in forming a virtual image of an object, because its focus is exterior to itself. The real inverted image formed by the objective is formed *outside* the positive ocular, which in this respect differs radically from the negative ocular, in which the real inverted image is formed *within* the ocular. The negative eye-piece cannot be used as a simple microscope, because its focus is within itself,—between the eye and the field lenses.

Positive eye-pieces are very rarely used at present, because they do not secure perfect definition. They have been superseded by the negative, or Huyghenian, eye-pieces. These consist of an upper or eye-lens and a lower or field-lens, both plano-convex, the former magnifying the real image formed by the objective as if that image were an object, while the latter collects the image-forming rays somewhat and thereby aids in the formation of the real image. The eye-lens is sometimes called the magnifying lens, and the field lens the collective lens; the last-mentioned lens is regarded by some microscopists as forming part of the objective rather than of the ocular.

The magnifying power of the ocular depends upon its equivalent focus; thus a lens of two inch (fifty millimetres) focus magnifies five diameters, while one of one-half inch (twelve and a half millimetres) focus magnifies twenty diameters. The oculars are designated by letters or figures generally, the higher the number, or the more advanced the letter in the alphabet, the greater the magnifying power.

It is not advisable to use the high power ocular, because what is gained in magnification is lost in definition and clearness. When one ocular only can be purchased, a medium power, one or one and a half inch focus, is to be preferred. When two oculars are obtainable, the one inch and the two inch, having a magnifying power of ten and five diameters respectively, are to be recommended.

Of the special eye-pieces the micrometer ocular is the most important. If the micrometer is to be used with a negative ocular, it is placed in the focus of the eye-lens and lies upon the real image formed by the objective. Both the micrometer scale and the real image are magnified, and the reading is thus easily made from the virtual image. If a positive lens is used, the micrometer must

be placed in the focus of the eye-piece itself. The Ramsden form, in which two plano-convex lenses are placed close together with the convex surfaces facing each other, is well adapted to this purpose. The ocular used for the micrometer should be of medium power, about one and a half inches focus.

The projection eye-piece is mainly intended for photo-micrography: the index eye-piece to point to the position of a detail of the object by means of a pointer placed at the diaphragm; the spectroscopic, polarizing, and binocular eye-pieces are self-explanatory as to their special function.

The defects commonly existing in oculars, which defeat in great part the excellences of a good objective, are want of achromatism and of flatness of field, and inequality of amplification throughout the whole extent of field. Various oculars have been devised to correct these faults, and have received such names as achromatic, aplanatic, orthoscopic, and the like. Great care should be exercised in selecting an ocular which is free from all these aberrations, as they are sometimes present in the best and most expensive lenses of first-class makers.

The Objective.—Everything in the form and construction, as well as in the nature of the optical and mechanical accessories of the microscope, is designed to contribute to the special work of the objective, or image-forming lens combination, which constitutes the basis of the optical properties of this instrument (Carpenter). The evolution of the objective from the crude glasses of Galileo and Drebbel to the highly efficient modern achromatic lenses has been a slow but a progressive one, in which achromatism has been the great object striven for. Indeed, the history of the modern objective dates from the time when its achromatism was finally determined. As now constructed, it consists of several lens combinations, the one nearest the object being called the front-system, and that farthest from it the back-system. Between the front and the back systems there may be one or more intermediate combinations. Generally each system consists of a convex lens of crown glass and a concave lens of flint glass, so disposed that the aberration of the one shall correct that of the other.

This combination of lens systems forming the objective forms a real, inverted, and enlarged image of the object, provided the latter is outside its principal focus. Herein the compound micro-

scope differs radically from the simple, in which the object is within its principal focus.

Objectives are known as dry, immersion, and homogeneous, according to the medium between the front system of lenses and the cover glass over the object. In the dry system, which is usually employed in all low- and medium-power objectives of from four-inch to one-sixth or one-eighth-inch focus, this space is occupied by air.

In the first immersion lenses, water was placed between the front lens and the cover-glass. These lenses gave decidedly better results than the dry system, and enjoyed increasing popularity until the homogeneous system of lenses was introduced in 1878. In this system, an oil having the same refractive and dispersive indices as the crown glass of the front lens, is placed in the space between the cover-glass and the objective, and as a result rays of light pass through these contiguous homogeneous substances without refraction or dispersion. Oil of cedar-wood is generally used for this purpose, and the objectives are, for this reason, popularly termed oil-immersion lenses. They mark a decided advance in the evolution of the microscope, and have been the means of bringing it almost to perfection.

Still another advance has been made in recent years in the introduction and perfection of the apochromatic lenses. This name, introduced by Professor Abbe, was given to a more perfect kind of achromatic lens, in which rays of three spectral colors, instead of rays of but two, as in the ordinary achromatic objectives, are combined at one focus. These lenses are made of a peculiar kind of glass, combined with fluorspar; they are very expensive, and deteriorate in hot, moist climates. Some makers claim that they do not use fluorspar, but absolutely permanent materials which will not deteriorate.

The following are the special characteristics of the lenses:

1. Three rays of different color and brought to one focus, leaving a small tertiary spectrum only.

2. The correction of the spherical aberration is obtained for *two* different colors in the brightest part of the spectrum, and the objective shows the same degree of chromatic correction for the marginal as for the central part of the aperture.

3. The optical and chemical foci are equivalent, and the image

formed by the chemical rays is much more perfect than that obtained with the old objectives, a property which renders the new objectives well adapted to micro-photography.

4. These objectives admit of the use of very high oculars (called compensating oculars) which correct a color-defect insensible at the centre of the field, increasing continuously towards the margin. (Gage.)

Objectives are designated, as a rule, by their equivalent focal length, expressed either in inches or millimetres. Thus a lens marked 2 means that it produces a real image of the same size as one formed by a simple converging lens having a focal length of two inches; hence the less the number and the smaller the fraction the greater the magnifying power of the objective, according to the law in optics that the relative size of object and image varies directly as their distance from the centre of the lens. Objectives are sometimes called "powers," and are grouped into three classes: low, medium, and high. The low powers are the three-inch, two-inch, one-and-a-half-inch, one-inch, two-thirds-inch, or three-fourths-inch objectives, giving a magnification with a two-inch ocular and tube length of one hundred and sixty millimetres of ten to fifty-five diameters. The medium powers are the four-tenths-inch, one-half-inch, one-quarter-inch, and one-fifth-inch objectives, giving a magnification of seventy-five to two hundred and thirty diameters; while the high powers include the one-sixth-inch, one-eighth-inch, one-tenth-inch, one-twelfth-inch, and one-sixteenth-inch objectives, giving a magnification of two hundred and sixty-five to twelve hundred diameters. The one-twentieth and one-twenty-fourth-inch objectives are now very rarely used. When the one-inch eye-piece is used these diameters will be doubled.

In selecting objectives for common laboratory or office work the following powers with their magnification are to be recommended.

	Magnification.
Two inch with two inch ocular	× 16
Three-fourths inch with two inch ocular	× 55
One-fifth inch with two inch ocular	× 230
One-twelfth inch with two inch ocular	× 750
Two inch with three-quarters inch ocular	× 40
Three-quarters inch with three-quarters inch ocular	× 130
One-fifth inch with three-quarters inch ocular	× 550
One-twelfth inch with three-quarters inch ocular	× 1400

Every objective should be tested for the six qualities enumerated below in the order of their importance.

1. Aperture.
2. Resolving power.
3. Penetrating power.
4. Flatness of field.
5. Defining power.
6. Magnifying power.

1. The angle which the most extreme rays transmitted through the objective make at the point of focus is called the *angular aperture* or the angle of the objective, and is its most important feature. In general, the angle increases with the diameter of the lenses forming the objective and the shortness of the equivalent focal distance; the angle also varies with the medium intervening between the cover glass and the front lens, being considerably greater with an immersion than with a dry front. The wider the angle the greater will be the quantity of light admitted through the system of lenses, and the resolving power of the lens will be correspondingly increased. It follows, then, that every degree thus added to the angular aperture increases the effectiveness of the objective, thus explaining the superiority of the homogeneous immersion over the water, and the water over the dry lens system. Of objectives of the same power, but of unequal angular aperture, the one of wider angle will show an object more brilliantly than the other; and if the difference be considerable, will make details of structure visible of which no trace can be discovered with a lens of narrower angle (Bausch). The term numerical aperture was introduced by Abbe to indicate the capacity of an optical instrument for receiving rays from the object and transmitting them to the image; and the aperture of a microscopic objective is therefore determined by the ratio between its focal length and the diameter of the emergent pencil at the point of its emergence; or, in other words, it is the index of refraction of the medium in front of the objective (air, water, or oil) multiplied by the size of half the angle of aperture.

2. The *resolution*, or *resolving* power of an objective, is the quality by which the intricate structure and the finer details of the object become manifest; and it is directly proportional to the numerical aperture of the lens,—in fact, it is synonymous with it.

It is a mistake to suppose that magnification will resolve or make clear a complex structure; when carried too far it blurs the object instead of clearing or resolving it. Objectives with low apertures and high magnification are much inferior for intricate work, as in bacteriology, to those of high aperture and low magnification; and the progress made in late years by the microscopical sciences is due in great part to the increased resolving power of the modern objectives.

3. *Penetration,* or *penetrating power,* is the quality by which different planes of an object are made manifest, and is the reciprocal of the resolving power. Resolution and penetration are antagonistic, and an objective especially adapted to the one will be deficient in the other. "In comparing the penetrating power of objectives of different foci, the numerical aperture being the same, it is found that the penetrating power increases directly as the square of the focus, and inversely as the square of the power. For example, two objectives of the same numerical aperture, one of four millimetres and the other of two millimetres focus, the penetrating power would be as $4^2 : 2^2$, or as $16 : 4$, or $4 : 1$. That is, the greater the equivalent focus the greater the penetration." (Gage.)

4. *Flatness of Field.*—The field of a microscope is that portion of the object which is observed in the eye-piece, and to say that an objective has good flatness of field implies that the spherical aberration has been in a great measure corrected. When this has not been accomplished the central and circumferential portions of the field are not equally clear and distinct. It is important to learn whether this defect is inherent in the ocular or whether it pertains to the objective only. This can be determined by observing whether it is constant when different objectives are used. It is almost impossible to eradicate completely spherical aberration in an objective, and the lens-maker's skill is tested to the utmost in obtaining the nearest approach to absolute flatness.

5. The *definition,* or *defining power,* of an objective depends on its freedom from chromatic and spherical aberrations and the perfect centring of the lenses. When these requirements have been met, a clear, sharp image of the object is obtained with abrupt outlines and no color-fringes or halos. Testing objectives is a difficult màtter. It is an art which few possess, and it can be acquired only by long practice. Although the aberrations may be in part or

wholly compensated, yet some fault may be present in the setting of the lenses whereby the alignment of their axes is imperfect or their planes are not parallel or not at right angles to the optic axis of the system.

6. The *magnification,* or *amplification*, of an objective is the least important of its necessary properties. The question is—not how much, but how well will a lens magnify; and the mistake is often made of securing high magnification at the expense of resolution and definition. Magnifying power may be increased by using, first, higher power objectives, or secondly, higher power oculars; and thirdly, by drawing out the draw-tube, thereby increasing the distance between the ocular and the objective.

THE COMPLEMENTARY PARTS.

Collectively, the complementary parts of a microscope consist of the stand, with its base, or foot, shaped like a horseshoe to insure firmness and steadiness for the finer mechanism which it supports. The pillar resting upon the base is jointed at its upper end to permit the superstructure to be placed in an inclined or upright position. Connected with the pillar at the joint is the arm which supports the working mechanism of the instrument. The upper part of the arm supports the body and the adjusting apparatus; while to the lower part are attached the stage, mirror, and condenser.

The body of the microscope is composed of a cylinder, or tube, fitted at its lower end with a thread for the insertion of the objective, while its upper end receives the ocular. A second tube, called the draw-tube, is generally inserted within the body-tube, and the ocular is then placed in this, allowing the distance between the objective and ocular to be increased by drawing out the inner tube, or decreased by pushing it in. The length of the tube varies, each maker having a standard of his own. Universal adoption of a uniform tube-length has been earnestly recommended by the American Microscopical Society through a committee, of which Professor Simon H. Gage, of Cornell University, was chairman, in 1890. This committee recommended a short or continental tube, one hundred and sixty millimetres, or six and three-tenths inches, in length, and a long tube of two hundred and sixteen millimetres, or eight and a half inches; and that the parts included should be those between

the upper end of the tube, in which the ocular is fitted, and the lower end of the tube, in which the objective is inserted. The draw-tube should be supplied with a scale graduated to either inches or millimetres, so that the proper tube-length may be ascertained. The interior of the tubes should be blackened to prevent reflection, and supplied with metal diaphragms so placed and shaped as to cut off entirely the unused light.

The movement of the body upon the arm for the purpose of focusing is called the coarse adjustment, and is best accomplished by means of a sliding rack and a stationary pinion having a shank, to which are attached two large milled heads, giving increased sensitiveness to the movement. This movement must be perfectly smooth, without any *back-lash,* and this end can be secured by having the teeth in the rack and pinion set obliquely.

The object of the fine adjustment is to obtain an exact focus, and consequently the motion it imparts to the body of the microscope is almost imperceptible. As now generally constructed in the continental type of microscopes, it consists of a fine screw controlled by a milled head, which acts upon the body either directly or through levers. It must be perfect in action and combine delicacy with rigidity and permanency. The movement must be easy, absolutely prompt, free from lateral displacement, and with a range of not less than an eighth of an inch.

The stage is the platform upon which objects are placed for examination. It should be of heavy material, preferably circular in form, well supported, and should have an aperture of from one and a half to two inches in diameter. It is supplied with two delicate clips of watch-spring steel to hold the object firmly to the stage.

The mirror should have two faces, one concave and one plane, from two and a half to three inches in diameter, and supported by a single or double crank-arm. This allows the mirror to swing upon an axis level with the object, and also to be brought above the stage for the illumination of opaque objects. It should be easily movable and delicately supported, so that it may be brought into any desired position. The concave mirror has a focus, a point at which the reflected rays all meet, and hence furnishes more intense illumination than the plane mirror. The plane mirror should be used in conjunction with the Abbe condenser.

THE ACCESSORY PARTS.

The substage of a modern microscope is of as much importance as any of the complementary parts. It is intended to receive and to enable us to use in the most effective manner the optical and other apparatus employed to illuminate the objects as required by the special power found needful. To it are attached the iris diaphragm, the condenser, the removable diaphragms, and the mirror bar.

The entire substage is supported on a heavy metal bar attached to the main arm of the microscope by a slide with rack and pinion, whereby the whole substage may be adjusted with reference to the microscope stage. It is supplied with a lateral or rectangular movement to centre the optical axis of the substage, so that it will coincide with that of the objective. The diaphragm has for its object the cutting off of all adventitious light, and is therefore placed immediately under the stage. It may consist of a perforated revolving disk with openings of various sizes, or a series of opaque disks, or the iris diaphragm. The latter consists of a series of overlapping blades placed around a central opening; by means of a small lever the aperture may be readily increased or diminished. When a low-power objective is used a large aperture is indicated; when a high-power is employed, a medium or a small aperture gives the best results.

The substage condensers are used only with the high-power immersion lenses, more especially in connection with bacteriological work. The most convenient form is the Abbe apparatus, the essential feature of which is a condenser system of very short focus which collects the light reflected by the mirror into a cone of rays of very large aperture and projects it on the object. Diaphragms of suitable size, or the iris diaphragm, are used to reduce this cone of light, unless it is desired to use the full aperture of the illuminating cone in studying deeply stained bacteria with objectives of large aperture. In order to get the best effects with the condenser, its principal optical axis must be continuous with that of the microscope, and the object must be in the focus of the condenser,—*i.e.*, at the apex of the cone of light produced by the condenser. (Gage.)

The following conditions are necessary in working with a condenser: 1. The plane mirror should always be used; 2. The whole

field must be illuminated; and, 3. The proper aperture must be used.

The bull's-eye condenser, used to illuminate opaque objects, is a plano-convex lens mounted on brass, having a heavy base with an upright pillar and fitted with a carrying rod adjustable in every direction.

The mechanical stage is a contrivance by means of which the object is carried from one part of the field to another, slowly, precisely, and continuously without contact of the hands with the side. It is especially useful when working with high powers, particularly in bacteriological research. It is usually provided with two movements at right angles to one another, either with both rack-and-pinion adjustment or with screw motion. The simple slide-carrier may be used when the mechanical stage is not obtainable; a stage with a circular revolving top and two centring screws with milled heads may be employed. The two latter devices answer best when low or medium power objectives are employed.

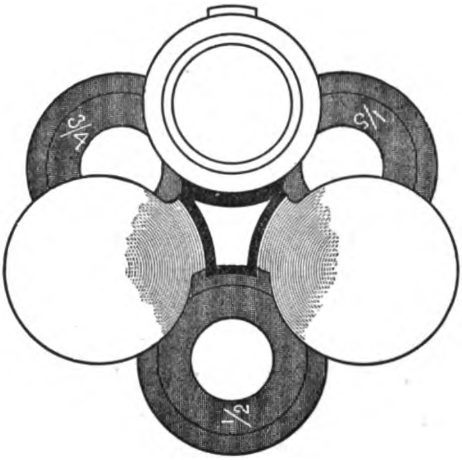
The nose-piece is an apparatus attachable to the lower end of the body-tube, for the reception of objectives of different power. Its object is to facilitate the changing of objectives when different powers are desired. On account of the increased weight put upon the fine adjustment by the accessories, it should not carry more than three objectives, and preferably only two. High powers and immersion lenses should never be allowed to remain on the nose-piece. In the proper use of a rotating nose-piece the length of the objective mount should be so arranged that when the objective is changed little focal adjustment is necessary. When working with the nose-piece it is sometimes difficult to see what power is being rotated into place. To obviate this difficulty the writer has suggested the engraving of the equivalent focus on the diaphragm above the back lens, which can be readily seen when rotating the nose-piece. (Fig. 10.)

The micrometer is a device for measuring the size of objects under examination. It is generally a circular piece of glass in the centre of which are equidistant rulings one-tenth or one-twentieth millimetre apart. It is placed in the ocular at the point where the real image formed by the objective falls; the image consequently appears to lie directly upon or under the micrometer. The number of lines which the object encompasses is read off and its

size determined by the ratio between the size of the real image and that of the object.

The camera lucida is an apparatus attached to the ocular, by means of which drawings of the image can be made by projecting it upon a table, where it can be easily sketched or drawn. These

FIG. 10.



are of many different kinds, some simple and others complex, but the principle of construction is the same in all. The Wallaston instrument is the oldest, and is very simple. Others, like Beale's, Schroeder's, Abbe and Zeiss's, are of more intricate mechanism, and therefore more expensive.

CARE OF THE MICROSCOPE.

The microscope is an instrument of precision, and some parts of its mechanism are as delicate as those of a watch; hence it is of the utmost importance to keep it scrupulously clean. Remove dust with a camel's-hair brush, then rub gently with a chamois skin along the grain of the finish, and not across it. If the brass parts are soiled by finger-marks, breathe upon them and then rub dry. Alcohol, acids, alkalies, turpentine, and chloroform should never be used on either the glass or brass parts. If the lacquering is soiled with oil or balsam, dissolve off with benzine; then rub dry quickly.

Keep the microscope in its case or under a tightly closed bell

jar when not in use, and when removing it grasp the arm firmly, and not the tube. Draw out the draw-tube with a spiral motion, and in telescoping the tubes be careful to keep the body-tube immovable and not to force the coarse adjustment. If dust collects between opposing brass surfaces and "cuts," separate them, clean carefully and lubricate with soft tallow or good clock oil. It is most important that the optical parts should be kept properly cleaned.

High-power objectives should always be removed from the nose-piece and placed in their cases. Low powers may remain on the nose-piece. Remove all particles of dust with a camel's-hair brush. If dust collects on the inner surfaces, unscrew the back lens and use a camel's-hair brush. Remove adherent balsam from front lens with benzine. Cloudy lenses are conveniently cleaned by breathing on them and wiping dry with a piece of old linen or Japanese lens paper. The liquid remaining on immersion lenses after use should also be wiped off with linen or Japanese paper. If cedar oil has been used, clean the front lens with benzine and dry thoroughly. Glycerin should be wiped off with water only. Never take the combination lenses apart in a high-power objective.

Keep the objectives where they will not be exposed to extreme or sudden changes of temperature, as the inequality in the expansion and contraction of glass and metal may cause the cement between the lenses to crack. Never allow an inexperienced person to handle a good microscope.

Monograph

THE SCIENTIFIC MODIFICATION OF MILK.

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CONTENTS.

PART I.—INTRODUCTORY.

PART II.—THE CALCULATION OF PERCENTAGE FORMULÆ.

PART III.—GENERAL CONSIDERATIONS OF SUBSTITUTE FEEDING.

Comparative Analyses of Cows' and Woman's Milk—Limitations of Simple Dilution—Digestive Equilibrium—First Rule in Feeding—The Living Ration of Milk Solids per Day—Management of the Fat Percentages—Management of the Proteid Percentages—Management of the Sugar Percentages—Diluents—Alkalinity—Partial Peptonization—Theoretical Scheme for the Percentages for a Healthy Infant—Special Indications for Modifying the Percentages—Unusual Conditions determining Loss of Weight or Failure to gain satisfactorily—Bacteriological Experiments—Simple Clinical Methods of Milk Analysis—Estimation of Breast-milk Proteids—Estimation of Fat.

PART IV.—THE PRACTICAL APPLICATION OF PERCENTAGE FEEDING.

Feeding from Birth—General Scheme of Percentages—Mixed Breast- and Bottle-feeding—Feeding after Early Weaning—Feeding in Acute Diseases.

PART I.

INTRODUCTORY.

Ever since the artificial feeding of infants has been practised clinical observation has proved that the very young infant is unable to digest satisfactorily the undiluted milk of the cow; and thus, long before comparative analyses of cows' milk and human milk were brought forward to explain the physiological reasons for this fact, various methods of modification for infant feeding, to use the term in its broadest sense, were commonly practised. The grandmother of the olden time who suggested a milk-and-water mixture for feeding her infant grandchild recognized the importance of this clinical fact, and practised modification of the milk just as truly as the modern mother who compounds her baby's bottle mixture according to the formula of her physician, with precautions of cleanliness and asepticism rivalling the routine practices of a bacteriological laboratory.

Until the establishment of milk laboratories in 1892, we lacked any rational system of prescribing milk mixtures, and were obliged to rely upon the teaching of our own slowly acquired experience, or to follow more or less closely the prescriptions of specialists in this branch of medicine who have studied the subject exhaustively.

The medical profession is under a debt of lasting gratitude to Dr. Thomas Morgan Rotch, of Harvard University, for his pioneer work in reducing the subject of infant feeding to a percentage basis. The inauguration of the milk laboratory has been not only a great scientific achievement in itself, but it has also been the means of changing the whole trend of professional thought upon this subject and of establishing the science of infant feeding upon an exact and rational basis. It has emphasized the fact, already known, that cows' milk is a physiological mixture containing fairly uniform percentages of fat, proteids, sugar, and mineral salts, and has shown that by various manipulations it is possible to alter the proportions of these ingredients so that almost unlimited variations in their percentages may readily be obtained. It has demonstrated that the percentage analysis of human milk may be exactly imitated in a mixture containing suitable proportions of cows' milk, cream, sugar of milk, and a diluent, and, again, that any one or all of these percentages may be varied to suit the special demands of the digestion in any given case. It has taught us, in short, that the only rational basis of comparison between substitute mixtures of cows' milk and the human mammary secretion is a mathematical one.

Thus we have come to think of milk mixtures in terms of the percentages of their ingredients rather than as combinations of varying quantities of cream, milk, water, and sugar. In this way the actual quantities of cream, milk, and sugar become entirely subsidiary, being dependent upon the percentage formula. Having once fixed upon an appropriate percentage formula, a few simple calculations, which can be made at the bedside, enable the physician to translate his percentage thoughts into the quantities of fluid measure which are to be used in preparing the modified mixture. Thus, we have not only made a decided advance towards simplicity, but have acquired a system of prescription writing capable of effecting the most delicate changes in dosage. In the ordinary combination of cream, milk, sugar, and water a change in the quantity of any one of these ingredients disturbs the quantities, and therefore the percentages, of all the organic elements. In a percentage mixture, however, the proportion of any one element may be altered without disturbing that of the others, and thus we are enabled to make unlimited changes in the composition of the mixture.

Percentage methods of feeding, again, have taught us that certain babies cannot digest certain combinations of milk, cream, and water that are perfectly borne by other infants of the same age, but can readily assimilate other mixtures differing from these by what seems an almost infinitesimal variation in some or all of the percentages. It is an experience that is doubtless familiar to all practitioners who have had much to do with the feeding of children, that some babies even in the second year are unable to take undiluted milk until near the end of this period. Time and again the effort to increase the proportion of milk, even by a tablespoonful in the day's feeding, will be promptly followed by disorder of the digestion, curdy stools, or even vomiting. This susceptibility to slight changes in the concentration of milk mixtures, which particularly concerns the proportion of the proteids, is even more pronounced in the first year, and is especially noticeable in infants whose digestion has been impaired by faulty feeding in the earlier months of life. In this class of cases one cannot too strongly emphasize the importance of a system which permits almost unlimited flexibility in the arrangement of the dosage of all the elements of the food.

It is well to remember at this point that a percentage formula is really an index of the dilution of the milk solids rather than an indication of the quantity of food that the child is to receive. Six ounces of a mixture containing 3 per cent. fat, 6 per cent. sugar, and 1 per cent. proteids contain twice as much nourishment as do three ounces, but the degree of dilution is the same. Moreover, a given percentage mixture can be made by various combinations of milk and cream, depending chiefly upon the percentage of fat in the cream used in each instance. For example, a formula of 3 per cent. fat and 1.50 per cent. proteids for a mixture of forty ounces, if made from 12 per cent. cream and whole milk, would require 7.3 ounces of this cream and 8.1 ounces of milk, while if a 16 per cent. cream were used, the quantities would be 4.8 ounces of cream and 10.8 ounces of milk. At the same time it must be noted, however, that the actual quantities of fat and proteids in the two mixtures are identical. But inasmuch as it is customary to give an artificially fed infant each day the same total quantity of food, a percentage system which represents a fixed proportion of the solids secures what might be termed a constant weight of food each day,

and thus the problem of weight-gain is simplified by making the daily ration of food-elements a constant quantity.

It is therefore evident that in prescribing a milk mixture for a child we really gauge his digestive capacity by our knowledge of the digestibility of dilutions of milk. In beginning the feeding of a new case the physician chooses what his experience would lead him to consider an acceptable dilution of the milk solids as expressed in percentage figures, and thus orders his mixture, fixing the quantity to be given at a feeding according to the well-known rules determined by the gastric capacity at each month of the child's life. If, then, the combination is found to disagree, the percentage formula must be modified in accordance with definite, well-recognized principles. So slight a variation as is produced by decreasing the percentage of one or all of the ingredients by one- or two-tenths of one per cent. may be found at once to correct the difficulty, and there is thus established a definite combination which, for the time being and for this particular infant, suits its strength of digestion. When this formula is once determined, the subsequent course is simple. It is then only necessary to feel one's way to a gradual increase of the concentration of the food, watching the bowel movements and the action of the stomach as indices of the condition of the child's digestion. In some cases the advance to higher percentages may be made with comparative rapidity, in others the power of digesting proteids increases very slowly, and it may require a week or two to work up gradually through even one-tenth of one per cent. of this element of the food. In every case, however, by careful observation the physician is enabled to estimate how rapidly or how slowly advances in the percentages must be made. In children with weak proteid digestion it is only through the delicate manipulations made possible by a percentage basis that satisfactory results can be obtained.

It is no unusual experience to be consulted about the diet of an infant, artificially fed from birth, whose digestion has been seriously impaired by milk mixtures entirely too strong for it. A popular idea that half milk and half water are a suitable combination for a very young infant is responsible for a large amount of the digestive troubles of early life. In refutation of this idea percentage feeding has demonstrated beyond a doubt that proportions of cream and milk averaging as low as one-third, one-fourth, or one-fifth of

the total quantity of the mixture agree much better and are appropriated more completely by many young infants than any stronger combination. This statement must, of course, be taken relatively. Some infants of robust fibre and normal constitution can appropriate much larger proportions of milk in the mixture than are here indicated. With such infants almost any reasonable dilution may be found to agree during the whole of the first year of life; and this is more commonly the case when the baby has already had the advantage of four or five months of breast feeding. But how often do we encounter cases of delicate infants deprived from birth of their mother's milk, who have been started on the downward road with a bottle mixture entirely unsuited to their needs! The appalling number of wasted, puny infants that constantly fill our dispensaries and consultation-rooms is a crying protest against unscientific methods of substitute feeding. It may be stated with confidence that a baby whose digestion is not overtaxed is a good baby and a sound sleeper. When night is constantly made hideous by a wakeful, crying infant, ninety-nine times out of one hundred the trouble lies primarily with the food and secondarily with the overtaxed digestion. In these cases a reduction of the percentages is followed by prompt and almost magical relief. The pain-racked little sufferer in a few days becomes quiet and sleeps naturally, and though taking an apparently insufficient amount of nourishment according to the older standards, begins to thrive and gain weight. It is really remarkable how small a quantity of milk and cream a day will satisfy the needs of such babies for a limited time. From four to six ounces' gain in weight a week will frequently follow the administration of five or six ounces of milk and cream, properly diluted for the day's feeding. Of course it must not be understood that such a small amount of milk food can be given indefinitely. With the improvement that is sure to follow, gradual advances in the daily ration of milk must be made until a proteid percentage between 1.50 and 2 or 2.50 and a fat percentage between 3 and 3.50, or even a little higher, are attained. Upon such a mixture, properly apportioned according to the capacity of the stomach, satisfactory gains can be made until the infant is well on towards the end of the first year. In every case the weekly gain in weight, the toleration of the stomach, the completeness of intestinal digestion, and the general comfort and well-being of the child must be taken as guides

in varying or increasing the proportions of the milk and cream in the mixture.

In speaking of the many advantages of this modern method of feeding, the fact must not be lost sight of that successful results in substitute feeding have been for years obtained upon purely empiric lines by exponents of the older methods. These results, however, were the outcome of long years of clinical experience, each physician having worked out his own system of milk formulæ after repeated experimentation, and each having his following of disciples to carry out his teachings. The percentage system of modification, on the other hand, belongs to no school and exploits no one's "mixture." It offers to the most inexperienced student of pediatrics, as well as to the veteran practitioner, a rational and scientifically accurate system of regulating the proportions of all the elements of an infant's diet from a study of its individual needs.

The suggestion that all prescriptions for modifications of milk should be expressed in percentages was made by Dr. Rotch in 1890, and in 1891 the idea was brought to the notice of those in charge of the Walker-Gordon Milk Laboratory by Mr. G. E. Gordon. The original plan contemplated the use of creams of various fat percentages to furnish all the fat and part of the proteids required in the modified mixture, the deficiency in proteids being then made up by the addition of the necessary amount of fat-free milk. The calculations for this form of modification were then determined by Mr. J. H. Waterhouse, of the Walker-Gordon Laboratory, who prepared elaborate tables giving the quantities of cream and fat-free milk required to make the various combinations of the percentages of fat, proteids, and sugar. These tables have ever since been used in the laboratories, but they have never been published. The possibility of applying the percentage system to modifications made with cream and whole milk, with a method of calculation, was suggested by the writer in 1897. Since then the method has been simplified and has been extended to other combinations of milk products, so that the present study is believed to be the first complete elucidation of the technique of scientific milk modification that has appeared.

In the system of modification originally suggested the writer adopted for convenience of calculation the standard analyses of laboratory milk and cream as given by Rotch,—namely, for 16 per cent. cream, 16 per cent. fat, 3.60 per cent. proteids, and 4 per

cent. sugar; for 12 per cent. cream, 12 per cent. fat, 3.80 per cent. proteids, and 4.20 per cent. sugar; and for whole milk, 4 per cent. fat, 4 per cent. proteids, and 4.50 per cent. sugar. It can be assumed as a working principle that the mixed milk of a large herd of ordinary cows will rarely exceed these figures, though it may among the fancy breeds. From these figures a series of simple formulæ can be derived by which the calculation of the proportions of milk, cream, and sugar required can rapidly be determined. Calculations for other combinations of the milk solids are also given, including simple cream dilutions, cream and separated (fat-free) milk, cream and its separated milk, and cream and whey. All of these are useful under appropriate conditions. There is no method of utilizing upper cream and under milk in the hands of nurses or mothers in the home that can equal in exactness the combination of definite percentage cream and whole milk. Unless otherwise stated, therefore, the mixtures mentioned in the text will be prepared from cream and milk of known exact percentages.

In deriving the various formulæ care has been taken to present all the mathematical work, so that, if interested in this aspect of the subject, the physician may be able to follow out the various steps and understand the reasons for employing each of the formulæ given. In actual practice, however, the quantities of cream, milk, sugar, and water are to be obtained by substituting the desired values in the terminal formulæ, which are printed in bold-face type,—a calculation that can readily be made at the bedside. If it is then found necessary to modify at home, the mother receives a prescription such as the following:

For 40 ounces of mixture, containing fat, 3.00; proteids, 1.50; sugar, 6.00. Eight bottles of 5 ounces each. Take of

Cream (16 per cent.)	4 oz. 6 drachms;
Milk.	10 oz. 5 drachms;
Sugar of milk	$1\frac{3}{4}$ oz.;
Water	24 oz. 5 drachms.

Mix, dissolving first the sugar in the water.

Nothing can be simpler than this for the mother; and after a little practice the physician will find that the necessary calculation adds very slightly to his own labor, while it gives him the command of a most delicate and valuable instrument of precision.

For the sake of uniformity with the terms used in *Pediatrics* by Rotch, the following definitions are to be understood:

Cream.—The product resulting from separating most of the fat from whole milk, containing also certain percentages of the other elements,—proteids and sugar.

Whole Milk.—The original product as it comes from the cow. It may be considered as a 4 per cent. cream.

Separated Milk.—Milk from which the fat has been partially or entirely removed, either by gravity raising or by centrifuge.

Fat-free Milk.—Separated milk which contains no fat or only a minute fractional percentage.

Whey.—A milk containing very low proteids and fat, the proteids being represented almost entirely by lactalbumin.

PART II.

THE CALCULATION OF PERCENTAGE FORMULÆ.

In reducing the problems of percentage feeding to a mathematical basis it first becomes necessary to adopt some standard of values upon which to base the requisite calculations. The average analysis of ordinary dairy milk has been found to conform quite closely to the following simple figures of percentage (Rotch):

Fat	4.00	Sugar	4.50
Proteids	4.00	Mineral salts	0.70

From such a basal milk the centrifuge yields creams with varying percentages of fat, which are known respectively as 8 per cent., 12 per cent., 16 per cent., 20 per cent., or 32 per cent. cream, with, of course, any number of possible intermediate creams containing different fat percentages. The five strengths mentioned, however, are those ordinarily employed, and the convenience of their percentages meets every necessary requirement.

It must be remembered that cream differs from the milk from which it is derived principally in the larger quantity of fat contained in it. Its proteid percentage is only slightly lower than that of the milk, the richer creams giving the greater variation, and none of those in ordinary use showing a proteid percentage as great as

1.00 below that of the milk from which it is derived. The sugar percentage of the various creams is also slightly lower than that of the milk, and the salts, too, suffer a very slight diminution. Cream, therefore, is practically a superfatted milk, and for the sake of uniformity it would be quite correct to consider whole milk as a 4 per cent. cream. The following table gives the analysis of whole milk and of the cream of various fat strengths derived from it:[1]

	Milk. (4 per cent. cream.)	8 per cent. cream.	12 per cent. cream.	16 per cent. cream.	20 per cent. cream.
Fat	4.00	8.00	12.00	16.00	20.00
Proteids	4.00	3.90	3.80	3.60	3.20
Sugar	4.40	4.30	4.20	4.00	3.80
Salts	0.70	0.70	0.64	0.60	0.55

For the ordinary purposes of modification at home, whole milk and one or other of these creams may be chosen, 12 or 16 per cent. cream being the most generally applicable. It may be desired, however, to obtain creams of similar strength by the process of gravity or setting. In this case it will be found that by setting a quart jar of milk in ice water, or upon ice, for four or five hours, about ten ounces of 8 per cent. cream can be obtained from the top; if six hours elapse, the quantity of cream will be reduced to about six ounces of 12 per cent. strength; while after twelve hours the ordinary 16 per cent. or gravity cream is obtained. Both separated (centrifugal) cream and gravity cream containing any per cent. of fat desired are now furnished by the laboratories. However, since the element of cost may be important, the necessary amount of cream, though not in exact percentages, can be obtained by skimming from a quart of bottled whole milk, and, if the quantity required be not too large, the remaining separated milk will be sufficient to furnish the weaker milk necessary to bring up the proteids. Or the separated milk may be neglected and a full strength 4 per cent. milk obtained from another bottle. This method is preferable to using ordinary dairy cream, which is inexact in percentage and dirty, since neither the cream nor the milk need then be more than from six to twelve

[1] Holt, Diseases of Infancy and Childhood, p. 142. Holt gives the average sugar percentage of whole milk as 4.30, and Rotch takes 4.50. The average of these two offers a convenient figure for calculation, and will be used throughout the text.

hours old,—a decided safeguard when it is remembered how quickly bacterial flora multiply in summer weather.

If the milk and cream are to be taken from one bottle, it is a very simple matter to calculate the percentage of fat in the separated milk.

Take, for instance, a quart of 4 per cent. milk from which, after standing five hours, ten ounces of 8 per cent. cream have risen: Thirty-two ounces of 4 per cent. (fat) milk contain 1.28 ounces of pure fat; ten ounces of 8 per cent. (fat) cream contain 0.80 ounce of pure fat; therefore, twenty-two ounces of separated milk contain 0.48 ounce of pure fat; which means twenty-two ounces of $2\ ^2/_{11}$ per cent. fat strength.

Again, for 12 per cent. cream: Thirty-two ounces of 4 per cent. (fat) milk contain 1.28 ounces of fat; six ounces of 12 per cent. (fat) cream contain 0.72 ounce of fat; therefore, twenty-six ounces of separated milk contain 0.56 ounce of fat; which means twenty-six ounces of $2^2/_{13}$ per cent. fat strength.

The proteid percentage of the separated milk can also be calculated in the same way. For 8 per cent. cream: Thirty-two ounces of 4 per cent. (proteid) milk contain 1.28 ounces of proteids; ten ounces of 3.9 per cent. (proteid) cream contain 0.39 ounce of proteids; therefore, twenty-two ounces of separated milk contain 0.89 ounce of proteids, equal to $4\ ^1/_{22}$ per cent.

For 12 per cent. cream: Thirty-two ounces of 4 per cent. (proteid) milk contain 1.28 ounces of proteids; six ounces of 3.8 per cent. (proteid) cream contain 0.228 ounce of proteids; therefore, twenty-six ounces of separated milk contain 1.052 ounces of proteids, equal to $4\ ^1/_{26}$ per cent.

These simple calculations show that in either case the remaining separated milk averages about 2 per cent. fat and 4 per cent. proteids.

By using the general formulæ [*6*] [*7*] and [*9*], special formulæ can be derived which can be used for the necessary calculations, reference to which will be made again in that connection. (See page 258.)

As can readily be shown, however, from these formulæ, the adaptability of 8 per cent. cream is rather limited, since a comparatively large proportion of it is required to give any of the usually desired fat percentages. The same is true, though to a less degree,

of 12 per cent. cream. In either case the low fat percentage of the separated milk necessitates the use of an unusually high proportion of cream to provide for the percentages of fat called for in the ordinary mixtures; and thus, except for very low percentages of fat and proteids and a moderate quantity of the mixture, one quart of milk is not sufficient to furnish all the milk solids required for the day's feeding. It is therefore generally necessary to use two bottles of milk, one for supplying the cream required, the other for furnishing an unseparated milk containing 4 per cent. of fat.

The Modification of Cream.—Modification of the fats of cream can be accomplished by mixing cream and whole milk in various proportions. Thus, 12 per cent. cream can be obtained by mixing equal parts of 20 per cent. cream and whole milk, or two parts of 16 per cent. cream and one of whole milk.

Eight per cent. cream can be obtained from one part 20 per cent. cream and three parts whole milk, or one part 16 per cent. cream and two parts whole milk.

Sixteen per cent. cream can be obtained by combining three parts 20 per cent. cream and one part whole milk. These modified creams differ very little in their proteid percentages from those obtained directly by the centrifuge.

Cream Dilutions.—Given a cream containing definite percentages of fat, proteids, and sugar, by simple dilution with equal or multiple quantities of water various mixtures are obtained in which the percentages of these three elements bear a fixed ratio to those of the cream used. The percentages of the dilution can easily be calculated by multiplying the percentages of the cream by a fraction, the numerator of which is the integer representing the quantity of cream and the denominator the integer representing the sum of the cream and the diluent. Thus, for 8 per cent. cream, with percentages of 8.00 fat, 3.90 proteids, and 4.30 sugar, a mixture of equal parts of cream and water would give in the resulting mixture one-half of the pure cream percentages,—that is, 4.00 fat and 1.95 proteids; a mixture of cream and twice its measure of water would give one-third of the cream percentages,—that is, 2.67 fat and 1.30 proteids; and a mixture of cream and three times its measure of water would give one-fourth of the cream percentages, or 2.00 fat and 0.975 proteids.

The resulting sugar percentage would also bear the same fixed

ratio to that of the sugar percentage of the cream. When sugar solutions are used as the diluent, the calculation of the sugar percentage can be made by the following formula, which expresses the fact that the sugar percentage of the dilution is the sum of the percentages contributed by the sugar solution and the cream:

[1] $$S = \frac{W \times s' + C \times c}{W + C},$$

in which S represents the resultant sugar percentage; W, the quantity of water, most simply considered as a multiple of the quantity of cream, which thus is represented by 1; s', the percentage of the sugar solution; c, the percentage of sugar in the cream; and C, the quantity of cream. For example, take the 8 per cent. cream just considered. A dilution with an equal quantity of any sugar solution would give 4.00 fat and 1.95 proteids. If a 5 per cent. sugar solution were used as a diluent, the sugar percentage in the dilution would be thus calculated:

$$S = \frac{(1 \times 5) + (1 \times 4.30)}{1 + 1} = \frac{9.30}{2} = 4.65 \text{ per cent.};$$

for an 8 per cent. sugar solution the calculation would be

$$S = \frac{(1 \times 8) + (1 \times 4.30)}{1 + 1} = \frac{12.30}{2} = 6.15 \text{ per cent.};$$

and for a 10 per cent. sugar solution,

$$S = \frac{(1 \times 10) + (1 \times 4.30)}{1 + 1} = \frac{14.30}{2} = 7.15 \text{ per cent.}$$

Again, for a dilution of one part of 12 per cent. cream to three parts of an 8 per cent. sugar solution, the resulting percentages would be 3.00 fat, 0.95 proteids, and the sugar percentage would be

$$S = \frac{(3 \times 8) + (1 \times 4.20)}{1 + 3} = \frac{28.20}{4} = 7.05 \text{ per cent.}$$

The fóllowing tables give the resulting percentages from various dilutions of 16, 12, 8, and 4 per cent. creams:

TABLE I.—Sixteen per cent. Cream.

(Fat 16.00, Sugar 4.00, Proteids 3.60.)

1 part of Cream to

15	parts	5	per cent.	sugar	solution	=	fat	1.00,	sugar	4.94,	proteids	0.23
15	"	6	"	"	"	=	"	1.00,	"	5.87,	"	0.23
15	"	7	"	"	"	=	"	1.00,	"	6.81,	"	0.23
9	"	5	"	"	"	=	"	1.60,	"	4.90,	"	0.36
9	"	6	"	"	"	=	"	1.60,	"	5.80,	"	0.36
9	"	7	"	"	"	=	"	1.60,	"	6.70,	"	0.36
7	"	5	"	"	"	=	"	2.00,	"	4.87,	"	0.45
7	"	6	"	"	"	=	"	2.00,	"	5.75,	"	0.45
7	"	7	"	"	"	=	"	2.00,	"	6.62,	"	0.45
5.4	"	5	"	"	"	=	"	2.50,	"	4.84,	"	0.56
5.4	"	6	"	"	"	=	"	2.50,	"	5.70,	"	0.56
5.4	"	7	"	"	"	=	"	2.50,	"	6.53,	"	0.56
4.3	"	5	"	"	"	=	"	3.02,	"	4.81,	"	0.68
4.3	"	6	"	"	"	=	"	3.02,	"	5.62,	"	0.68
4.3	"	7	"	"	"	=	"	3.02,	"	6.43,	"	0.68
3.6	"	5	"	"	"	=	"	3.48,	"	4.78,	"	0.78
3.6	"	6	"	"	"	=	"	3.48,	"	5.56,	"	0.78
3.6	"	7	"	"	"	=	"	3.48,	"	6.35,	"	0.78
3	"	5	"	"	"	=	"	4.00,	"	4.75,	"	0.90
3	"	6	"	"	"	=	"	4.00,	"	5.50,	"	0.90
3	"	7	"	"	"	=	"	4.00,	"	6.25,	"	0.90
3	"	8	"	"	"	=	"	4.00,	"	7.00,	"	0.90

TABLE II.—Twelve per cent. Cream.

(Fat 12.00, Sugar 4.20, Proteids 3.80.)

1 part of Cream to

11	parts	5	per cent.	sugar	solution	=	fat	1.00,	sugar	4.93,	proteids	0.32
11	"	6	"	"	"	=	"	1.00,	"	5.85,	"	0.32
11	"	7	"	"	"	=	"	1.00,	"	6.76,	"	0.32
7	"	5–7	"	"	"	=	"	1.50,	"	4.90–6.65,	"	0.48
5	"	5–7	"	"	"	=	"	2.00,	"	4.87–6.53,	"	0.63
3.8	"	5–8	"	"	"	=	"	2.50,	"	4.83–7.20,	"	0.79
3	"	5–8	"	"	"	=	"	3.00,	"	4.80–7.05,	"	0.95
2.4	"	5–8	"	"	"	=	"	3.53,	"	4.76–6.88,	"	1.12
2	"	5–8	"	"	"	=	"	4.00,	"	4.73–6.73,	"	1.27

TABLE III.—Eight per cent. Cream.

(Fat 8.00, Sugar 4.30, Proteids 3.90.)

1 part of Cream to

7	parts	5– 7	per cent.	sugar	solution	=	fat	1.00,	sugar	4.91–6.66,	proteids	0.49
3	"	5– 8	"	"	"	=	"	2.00,	"	4.82–7.07,	"	0.97
1.6	"	5– 8	"	"	"	=	"	3.07,	"	4.73–6.58,	"	1.44
1	"	5–10	"	"	"	=	"	4.00,	"	4.65–7.15,	"	1.95

TABLE IV.—Four per cent. Cream (whole Milk).

(Fat 4.00, Sugar 4.40, Proteids 4.00.)

1 part of Milk to

11 parts	5– 7 per cent. sugar solution	=	fat 0.33,	sugar	4.95–6.78,	proteids	0.33
7 "	5– 7 " " "	=	" 0.50,	"	4.92–6.67,	"	0.50
3 "	5– 8 " " "	=	" 1.00,	"	4.85–7.10,	"	1.00
1 "	5–10 " " "	=	" 2.00,	"	4.70–7.20,	"	2.00

3 parts of Milk to

1 part 5–10 per cent. sugar solution = fat 3.00, sugar 4.60–5.85, proteids 3.00

It will be seen that by these various dilutions of creams, and by intermediate dilutions not carried out in the tables, a large number of combinations of fat and sugar can be obtained, but that the proteid percentage in any instance must bear the same ratio to the fat percentage as holds in the cream from which the dilution is made. Low or mean percentages of fat with high percentages of proteids cannot be obtained without additional proteids from separated milk. Finer variations in the relative proportions of fat and proteids, which are easily managed in laboratory modification, are thus impossible by the method of cream dilution. The practical value of the method for proteids therefore ends with a 1 to 1 dilution of whole milk, since the fat percentage cannot exceed that of the proteid when proteid percentages above 2.00 are desired, these two percentages remaining equal for any degree of fractional dilution.

The various strengths of sugar solutions can be made by dissolving an ounce of milk-sugar in twenty ounces, sixteen and one-half ounces, fourteen and one-quarter ounces, twelve and one-half ounces, or ten ounces of boiled or distilled water for 5, 6, 7, 8, and 10 per cent. solutions respectively.

Formulæ for combining Cream and Whole Milk.—The first published formulæ for cream and whole milk modifications were suggested by the writer in a paper read before the Philadelphia Pediatric Society in October, 1897, which was published in the *Archives of Pediatrics,* January and February, 1898. The method was somewhat laborious, since it required first the calculation of the amount of mixed milk and cream necessary to give the desired proteid percentage, but the practical results were perfectly satisfactory. Following this came formulæ suggested by William L. Baner (*New York Medical Journal,* March 12, 1898), and later Coit's decimal

system (*Archives of Pediatrics,* May, 1898). About a year later Dr. Fielding Lewis Taylor (*Pediatrics,* March 1, 1899, p. 205) published a set of formulæ which generalized the calculations and permitted the use of every possible combination of percentages in the basal milk and cream. Taylor's formulæ must therefore be accepted as the groundwork of every system of calculation for percentage formulæ, and their consideration will first claim our attention.

Taylor's General Formulæ.—The following symbols are readily understood and will be used with the same equivalents throughout the text:

The desired percentage of fat $= F$.

The desired percentage of proteids $= P$.

The desired percentage of sugar $= S$.

M represents the quantity of milk in fluid ounces; C, cream; W, water; and L, lactose in ounces (dry).

a and a' represent the known percentage of fat in cream and milk, respectively.

b and b' represent the known percentage of proteids in cream and milk, respectively.

c and c' represent the known percentage of sugar in cream and milk, respectively.

Since the actual quantity of proteids in the mixture is equal to the actual quantity of proteids of the milk plus that of the proteids of the cream; and since the actual quantity of fat in the mixture is also the sum of the fat of the milk and the fat of the cream, the following fundamental equations express these facts:

[2] $$Q\,P = b'\,M + b\,C.$$

[3] $$Q\,F = a'\,M + a\,C.$$

And since the actual quantity of sugar in the mixture is the sum of the quantities in the milk and cream plus the additional quantity necessary to bring it up to the desired percentage, we obtain

[4] $$Q \times \frac{S}{100} = \frac{c'}{100} \times M + \frac{c}{100} \times C + L.$$

By transposition of equation [2] so as to obtain a value for C, we obtain the equation

[5] $$\mathrm{M} = \frac{\mathrm{Q\,P - b\,C}}{\mathrm{b'}}.$$

Now, if this value of M be substituted in equation [3] we obtain

$$Q\,F = a\,C + \frac{a'}{b'}(Q\,P - b\,C),$$

or

$$b'\,Q\,F = a\,b'\,C + a'\,Q\,P - a'\,b\,C;$$

or, by transposing,

$$b'\,Q\,F = a\,b'\,C - a'\,b\,C + a'\,Q\,P;$$

whence

$$(a\,b' - a'\,b)\,C = b'\,Q\,F - a'\,Q\,P;$$

therefore

$$\text{[6]} \qquad \mathbf{C} = \frac{\mathbf{Q\,(b'\,F - a'\,P)}}{\mathbf{a\,b' - a'\,b}}.$$

From equation [4] by transposition we obtain

$$\text{[7]} \qquad \mathbf{L} = \frac{\mathbf{Q\,S - (c'\,M + c\,C)}}{\mathbf{100}}.$$

To these may be added the self-evident formula

$$\text{[8]} \qquad \mathbf{W = Q - (C + M)}.$$

A rather simpler formula for M can be derived from [3], which makes use of the integers representing the fat percentages rather than the mixed decimals representing the proteids, as Taylor's formula for M requires. Thus, by transposition of [3],

$$a'\,M = Q\,F - a\,C,$$

whence

$$\text{[9]} \qquad \mathbf{M} = \frac{\mathbf{Q\,F - a\,C}}{\mathbf{a'}}.$$

The Author's Formulæ.—The original formulæ suggested by the writer depended upon the calculation of the amount of combined milk and cream required to give the desired proteid percentage of the mixture, a factor 3.80 being assumed as the average proteid percentage of mixed milk and cream when 16 per cent. cream and whole milk were to be employed, or 3.90 when 12 per cent. cream and whole milk were chosen. This quantity of mixed milk and cream, represented by the symbol x, is readily calculated from the equation

$$\text{[10]} \qquad x = \frac{P \times Q}{3.80 \text{ or } 3.90}.$$

From the fact that the percentage of fat in the mixture derivable from the cream bears the same relation to the total fat percentage of the cream as the quantity of cream bears to the total quantity of mixture; and from a similar ratio with regard to the percentage of fat derivable from the milk used, the two following formulæ for 16 per cent. cream and milk were derived, y representing the fat percentage from the cream, and z that from the milk, the sum of which gives the fat percentage desired in the mixture, F:

[11] $$\frac{y}{16} = \frac{C}{Q} \text{ or } y = \frac{16\,C}{Q}.$$

[12] $$\frac{z}{4} = \frac{M}{Q} \text{ or } z = \frac{4\,M}{Q}.$$

Now, since

$$y + z = F,$$

and

$$M = x - C,$$

by adding equations [*11*] and [*12*] we obtain

$$y + z = F = \frac{16\,C + 4\,x - 4\,C}{Q} = \frac{12\,C + 4\,x}{Q};$$

whence

$$12\,C = Q\,F - 4\,x$$

and

[13] $$C = \frac{Q\,F - 4\,x}{12};$$

or when 12 per cent. cream is used

[14] $$C = \frac{Q\,F - 4\,x}{8}.$$

After finding the amount of C, the amount of M is obtained by subtracting from the value of x, already found. The sugar formula was

[15] $$L = \frac{Q\,S - 4.3\,x}{100}.$$

A somewhat simpler and more direct calculation of C can be made by deriving formulæ from Taylor's fundamental formulæ [*2*] and [*3*]. Thus,—

$$b'\,M = P\,Q - b\,C$$

$$a'\,M = F\,Q - a\,C.$$

Since the proteid percentage of milk (4.00) is assumed to be equal to its fat percentage (4.00), it is readily seen that the first members of these equations become equal to each other; therefore the second members are also equal, and this is expressed by

$$P\,Q - b\,C = F\,Q - a\,C,$$

or

$$(a - b)\,C = F\,Q - P\,Q,$$

whence

[16] $$C = \frac{(F - P)}{a - b}\,Q;$$

and since $a - b$ represents the difference between the percentages of fat and proteids in the cream used, we may rewrite the equation, using for the denominator of the fraction 12 — 3.8 (= 8.2), 16 — 3.6 (= 12.4), or 20 — 3.2 (= 16.8) as 12 per cent., 16 per cent., or 20 per cent. cream is chosen:

[17] $$\mathbf{C} = \frac{(\mathbf{F} - \mathbf{P})\,\mathbf{Q}}{\mathbf{8.2 \text{ or } 12.4 \text{ or } 16.8}}.$$

Again, from equation [*3*], by transposition,

$$a'\,M = Q\,F - a\,C;$$

whence

[18] $$M = \frac{Q\,F - a\,C}{a'}.$$

And since for 12 per cent. cream $a = 12$ and $a' = 4$, for 16 per cent. cream $a = 16$ and $a' = 4$, and for 20 per cent. cream $a = 20$ and $a' = 4$, this equation becomes

[19] $$\mathbf{M} = \frac{\mathbf{Q\,F}}{\mathbf{4}} - \mathbf{3\,C \text{ or } 4\,C \text{ or } 5\,C}.$$

Again, the cream to be used may not reach a fat percentage higher than 10 per cent., after standing six hours in ice-water, as Dr. Rotch's observations have led him to conclude (*Pediatrics,* p. 279). In this case the formulæ will be somewhat modified. Thus,—the proteid value of a 10 per cent. cream from milk containing 4 per cent. fat and 4 per cent. proteids may be taken as a mean between the 3.80 of 12 per cent. cream and the 3.90 of 8 per cent. cream,—namely, 3.85, and by substitution in [*16*] and [*18*] we obtain

[20] $$\mathbf{C} = \frac{(\mathbf{F} - \mathbf{P})\,\mathbf{Q}}{\mathbf{10 - 3.85}} = \frac{(\mathbf{F} - \mathbf{P})\,\mathbf{Q}}{\mathbf{6.15}},$$

and

[21] $$M = \frac{Q F - 10 C}{4}.$$

According to the standard percentages assumed for calculation, the sugar percentage of a mixture of milk and cream will differ very little from that of whole milk, especially when the proportion of milk is considerably greater than that of the cream, as it is in most of the commonly used percentage formulæ made with 16 per cent. cream. If an average percentage of 4.3 be accepted, general formula [7] may be simplified by using this factor instead of separate values for c and c'. The sugar formula thus becomes

[22] $$L = \frac{Q S - 4.3\,(M + C)}{100}.$$

These formulæ [*17*] [*19*] and [*22*] with [*20*] and [*21*] are at once simple and, for the assumed constants, absolutely accurate. They will be used hereafter for the calculations throughout the text, unless it be otherwise specified.

Apparently Impossible Combinations.—It will occasionally happen that the calculations for a particular formula give a negative quantity for the milk. For example, required the proportions of milk and 12 per cent. cream to give six ounces of mixture containing fat 4.00 and proteids 1.00. By formulæ [*17*] and [*19*]

$$C = \frac{(4 - 1)\,6}{8.2} = \frac{18}{8.2} = 2.2 \text{ ounces.}$$

$$M = \frac{6 \times 4}{4} - 6.6 = \quad - 0.6 \text{ ounce.}$$

It is evident here that a 12 per cent. cream is too weak in fat to give a sufficiently small quantity of cream to fall below one-third part of the total quantity of mixture and thus give a positive value for M. A higher fat cream must therefore be chosen. With 16 per cent. cream the result is

$$C = \frac{(4 - 1)\,6}{12.4} = \frac{18}{12.4} = 1.45 \text{ ounces.}$$

$$M = \frac{6 \times 4}{4} - 5.8 = 0.2 \text{ ounce.}$$

The conditions determining the strength of cream to be chosen for any desired modification of cream and whole milk can be generalized according to the following principles.

The Limitations of Modification with Regard to the Strength of Cream used.—It is quite evident from a study of the general milk formula [*9*] that, if $a\ C$ is greater than $Q\ F$, M becomes a negative quantity,—that is to say, the quantity of cream called for supplies a proteid percentage higher than is desired, even without the additional percentage derivable from the milk. The remedy for this is to make use of a higher-fat cream, whose proteid value will be lower. The lowest limit of proteid percentage obtainable with any given cream, and without additional milk, would therefore be determined when the formula for milk [*9*] gives a value of 0. This is seen to be the case when $Q\ F$ is equal to $a\ C$. If this equality be assumed, the relation between the fat and proteid percentages of a mixture requiring cream only can be reduced to a definite ratio for each fat percentage of cream. Thus,—

$$Q\ F = a\ C.$$

Substituting the value of C from [*16*],

$$Q\ F = \frac{(F - P)\ Q}{a - b} \times a,$$

or

$$(a - b)\ Q\ F = (a\ F - a\ P)\ Q,$$

from which Q can be eliminated, giving

$$(a - b)\ F = a\ F - a\ P.$$

By transposing,

$$a\ P = a\ F - a\ F + b\ F,$$

whence

[23] $$\mathbf{P} = \frac{\mathbf{b\ F}}{\mathbf{a}}.$$

If in this equation the values for a and b with 20 per cent., 16 per cent., 12 per cent., 10 per cent., 8 per cent., and 4 per cent. creams respectively be substituted, we obtain formulæ expressing the lowest percentage of proteids obtainable from each of these strengths of cream:

For 20 per cent. cream,

[24] $$P = \frac{3.20\ F}{20} = 0.16\ F.$$

For 16 per cent. cream,

[25] $$P = \frac{3.60\ F}{16} = 0.225\ F.$$

For 12 per cent. cream,

[26] $$P = \frac{3.80\ F}{12} = 0.3167\ F.$$

For 10 per cent. cream,

[27] $$P = \frac{3.85\ F}{10} = 0.385\ F.$$

For 8 per cent. cream,

[28] $$P = \frac{3.90\ F}{8} = 0.4875\ F.$$

For 4 per cent. cream,

[29] $$P = \frac{4.00\ F}{4} = 1.000\ F.$$

Thus it will be seen that for 2 per cent. fat in the mixture the proteid percentage must equal or exceed 0.32 with 20 per cent. cream, 0.45 with 16 per cent. cream, 0.63 with 12 per cent. cream, 0.77 with 10 per cent. cream, 0.97 with 8 per cent. cream, and 2.00 with 4 per cent. cream (whole milk).

For 3 per cent. fat in the mixture the proteid percentage must equal or exceed 0.48 with 20 per cent. cream, 0.67 with 16 per cent. cream, 0.95 with 12 per cent. cream, 1.15 with 10 per cent. cream, 1.46 with 8 per cent. cream, and 3.00 with 4 per cent cream (whole milk).

For 4 per cent. fat in the mixture the proteid percentage must equal or exceed 0.64 with 20 per cent. cream, 0.90 with 16 per cent. cream, 1.27 with 12 per cent. cream, 1.54 with 10 per cent. cream, 1.95 with 8 per cent. cream, and 4.00 with 4 per cent. cream (whole milk).

To put this in a different way, let us transpose [*23*] to get a value for F, then

[30] $$F = \frac{a\,P}{b}.$$

Now, for 12 per cent. cream this equation becomes

[31] $$F = \frac{12\,P}{3.8} = 3.15\,P.$$

By taking various values for P, such as 0.50, 0.75, 1.00, 1.25, etc., and substituting in this formula, we find the highest fat percentages that can be obtained by the use of a 12 per cent. cream without additional whole milk.

Similarly, for 16 per cent. cream [*30*] becomes

[32] $$F = \frac{16\,P}{3.6} = 4.44\,P,$$

for 20 per cent. cream [*30*] becomes

[33] $$F = \frac{20\,P}{3.2} = 6.25\,P,$$

and for 32 per cent. cream [*30*] becomes

[34] $$F = \frac{32\,P}{2.8} = 11.43\,P.$$

By working out these four formulæ for various proteid values the following table is obtained, showing the limitations of the various creams in practical modification:

For 0.50 P. Use 12 per cent. cream for fat values up to 1.57, 16 per cent. cream from 1.57 to 2.22, 20 per cent. cream from 2.22 to 3.125, and 32 per cent. cream above 3.125.

For 0.75 P. Use 12 per cent. cream for fat values up to 2.36, 16 per cent. cream from 2.36 to 3.33, and 20 per cent. cream from 3.33 to 4.69.

For 1.00 P. Use 12 per cent. cream for fat values up to 3.15, and 16 per cent. above 3.15.

For 1.25 P. Use 12 per cent. cream for fat values up to 3.94, and 16 per cent. above 3.94.

For 1.50 *P*. Use 12 per cent. or 16 per cent. cream for any modification.

For 1.75 *P*. Use 12 per cent. or 16 per cent. cream for any modification.

For 2.00 *P*. and higher } Use 12 per cent. or 16 per cent. cream for any modification.

Since 16 or 20 per cent. cream can always be used when 12 per cent. cream is practicable, a general rule may be derived. Thus,—

For 0.50 *P*. Use 16 per cent. cream up to 2.22 *F*, 20 per cent. cream from 2.22 *F* to 3.125 *F*, and 32 per cent. above this.

For 0.75 *P*. Use 16 per cent. cream up to 3.33 *F*, and 20 per cent. above this.

For 1.00 *P*. and higher } Use 16 per cent. cream exclusively.

When *P* equals *F* in formula [*17*] it is evident that the value of *C* is 0, or, in other words, the mixture becomes a simple dilution of milk which gives equal percentages of proteids and fat.

When *P* is greater than *F* the value of *C* becomes a negative quantity, which indicates that the milk needs the addition of proteids without fat, as they exist in separated (fat-free) milk. The calculation of the quantities for such a mixture can be carried out by the formulæ given in the following section, in which milk (4 per cent. cream) is to be used for *C*. In practice, however, it is extremely unusual to have the fat percentage lower than that of the proteids, so that separated milk would but rarely be required.

Formulæ for combining Cream and Separated (Fat-free) Milk.—It is sometimes desirable to make a modification by using cream of definite fat strength with a separated (*i.e.,* fat-free) milk. In this case the separated milk takes the place of the whole milk, its fat value (a') becoming 0 and its proteids (b') 4. Thus, equation [*6*] becomes

[35] $$C = \frac{Q\,(b'\,F - 0 \times P)}{a\,b' - 0 \times b} = \frac{Q\,(b'\,F)}{ab'} = \frac{Q\,F}{a},$$

and equation [*5*] becomes

[36] $$M = \frac{Q\,P - b\,C}{b'} = \frac{Q\,P - b\,C}{4}.$$

Since a represents the fat coefficient of the cream to be used, formula [*35*] may be expressed for 10, 12, or 16 per cent. cream,

$$[37] \qquad C = \frac{Q\,F}{10,\,12 \text{ or } 16};$$

and since formula [*36*] will vary according to the value of b, the proteid percentage of the cream used, it may be expressed, for these three strengths of cream, thus,—

$$[38] \qquad M = \frac{Q\,P - 3.85\,C}{4} \text{ or } \frac{Q\,P - 3.80\,C}{4} \text{ or } \frac{Q\,P - 3.60\,C}{4}.$$

The calculation for sugar may be made by substituting the appropriate values in equation [*7*]

$$L = \frac{Q\,S - (c'\,M + c\,C)}{100}.$$

To determine the Percentages in any Combination of Cream, Milk, and Sugar.—It is often a matter of considerable importance to know the percentages of fat, proteids, and sugar in any mixture composed of known quantities of cream, milk, milk-sugar, and water. These can be obtained by substituting the known values in formulæ [*17*] and [*19*], finding first the value for F in [*19*] and then substituting this in [*17*]. For integral percentages this calculation offers little difficulty as an algebraic problem; but it becomes quite tedious when mixed decimal percentages are involved. A more direct and quite simple method is offered by the following:

For fat percentage:

$$[39] \qquad \left\{ \begin{array}{l} \frac{C}{Q} \times 16 \text{ or } 12 = \text{fat percentage from cream.} \\ \frac{M}{Q} \times 4 \qquad\qquad = \text{fat percentage from milk.} \\ \hline \text{Sum of these} = \text{fat percentage in mixture.} \end{array} \right.$$

For proteid percentage:

$$[40] \qquad \left\{ \begin{array}{l} \frac{C}{Q} \times 3.6 \text{ or } 3.8 = \text{proteid percentage from cream.} \\ \frac{M}{Q} \times 4 \qquad\qquad = \text{proteid percentage from milk.} \\ \hline \text{Sum of these} = \text{proteid percentage in mixture.} \end{array} \right.$$

For sugar percentage:

$$[41]\quad \begin{cases} \dfrac{C}{Q} \times 4. \text{ or } 4.20 = \text{sugar percentage from cream.} \\ \dfrac{M}{Q} \times 4.4 \qquad = \text{sugar percentage from milk.} \\ \hline \text{Sum of these} = \text{sugar percentage in mixture,} \\ \text{without the additional sugar.} \end{cases}$$

The total percentage of sugar can be found most easily by substituting in the following formula, which is derived from [*22*] by transposition and takes into account the added sugar of milk:

$$[42]\qquad \text{Sugar percentage} = \frac{100\,L + 4.3\,(M + C)}{Q}$$

Formulæ for combining Cream and its Separated Milk.—It has already been stated that gravity cream of 8 or 12 per cent. strength, as obtained by setting the milk bottle on ice for varying lengths of time, could be used in connection with its separated milk, which has been shown to contain about 2 per cent. of fat and 4 per cent. of proteids.

For 12 per cent. cream and its separated milk the following formulæ are obtained by substitution in [*6*] and [*9*]:

$$[43]\qquad C = \frac{Q\,(4\,F - 2\,P)}{12 \times 4 - 2 \times 3.80} = \frac{2\,Q\,(2\,F - P)}{48 - 7.6} = \frac{Q\,(2\,F - P)}{20.2}$$

and

$$[44]\qquad M = \frac{Q\,F - 12\,C}{2} = \frac{Q\,F}{2} - 6\,C$$

The calculation for sugar can be made by [*22*].

According to Dr. Rotch's (*Pediatrics,* p. 278) method of home modification, a quart of a 4.00 F — 4.50 S — 4.00 P milk is set in a jar in ice and water for six hours, with some salt in the proportion of one teaspoonful to the quart of water, and at the expiration of this time twenty-four ounces of the under milk are drawn from the bottom of the jar by siphon. The remaining eight ounces of cream, Dr. Rotch states, average about 10 per cent. of fat.

By a calculation similar to that given on p. 243 the separated milk is shown to contain 0.48 ounce of fat distributed in its twenty-

four ounces, which means a fat percentage of 2. For purposes of calculation the proteid percentage of this 10 per cent. cream may be taken at about 3.85, which is midway between the figures for 8 and 12 per cent. creams. The calculation shows that the proteid percentage of the separated milk is 4 $^1/_{24}$ per cent.,—practically 4 per cent. By substituting 10 for a, 2 for a', 3.85 for b, and 4 for b' in formulæ [*6*] and [*9*], the following are obtained:

$$[45]\quad C=\frac{Q\,(4\,F-2\,P)}{10\times 4-2\times 3.85}=\frac{2\,Q\,(2\,F-P)}{40-7.70}=\frac{2\,Q\,(2\,F-P)}{32.30}=\frac{Q\,(2\,F-P)}{16.15}$$

and

$$[46]\quad M=\frac{Q\,F-10\,C}{2}=\frac{Q\,F}{2}-5\,C.$$

The sugar calculation can be made by means of formula [*22*].

Formulæ for Cream and Whey Mixtures.—For reasons which will be given in a later portion of the text, it is sometimes desirable in low proteid mixtures to secure a larger proportion of lactalbumin than can be obtained by a simple dilution of the total proteids of milk and cream. This can readily be done by applying the general formulæ [*6*] [*7*] and [*9*], considering the whey as a milk containing very low proteids and fat, the proteids here being represented almost entirely by lactalbumin. Koenig gives the following analysis of whey:

Proteids	0.86	Salts	0.65
Fat	0.32	Water	93.38
Sugar	4.79		

In the general formulæ, then, a' will be represented by 0.32, b' by 0.86, and c' by 4.8, and thus the special formulæ will be

$$[47]\quad C=\frac{Q\,(0.86\times F-0.32\times P)}{9.1\text{ or }12.6},$$

9.1 or 12.6 being used as divisor as 12 per cent. or 16 per cent. cream is used,

$$[48]\quad \text{Whey}=\frac{Q\,F-12\,C}{0.32}\text{ or }\frac{Q\,F-16\,C}{0.32},$$

and

$$[49]\quad L=\frac{Q\,S-(4.8\times \text{Whey}+12\text{ or }16\,C)}{100}.$$

In such a combination sufficient diluent must be added to make up to the total quantity. Since the excess of pepsin in the whey is apt to precipitate the caseinogen of the cream proteids and makes a lumpy, curdy mixture, it is better to raise the whey to a temperature of 170° F. for twenty minutes, in order to destroy the rennin, and then to cool before mixing with the cream, especially when the total quantity of food for twenty-four hours is prepared at one time. This, however, seems to be unnecessary when the whey is added to cream and milk mixtures which have been partially peptonized. In this case the amount of whey to be added should be first decided upon, and then this quantity should be deducted from the quantity of diluent used, so that when the whey is added the total quantity shall not be altered. If this be done the increase in proteids contributed by the whey can be calculated by multiplying 0.86 by the number of ounces of whey and dividing this product by the total number of ounces.

Since the proteid (lactalbumin) percentage of whey is less than 1, a very nutritious mixture may be obtained by using undiluted whey and bringing up the fat percentage by the addition of cream. In this case, since there is no diluent, the fat percentage cannot be varied altogether at will, but must depend upon the proteid percentage desired, and *vice versa.* The proteid percentage, however, for any definite fat percentage can be varied by making use of different grades of cream. Thus, with 3 *F*, proteids ranging from 1.18 (from 20 per cent. cream) up to 1.92 (from 8 per cent. cream) can be obtained, and with 4 *F* a variation of proteids between 1.30 and 2.32 can similarly be obtained.

The following formulæ, from which this calculation can be made, are derivable from equations expressing the fact that the proteid or the fat percentage of the mixture is equal to the sum of the proteid or the fat percentages contributed by the cream and the whey:

$$P = \frac{C \times b}{Q} + \frac{Wh \times b'}{Q},$$

$$F = \frac{C \times a}{Q} + \frac{Wh \times a'}{Q};$$

whence

$$Q\,P = C\,b + Wh\,b', \text{ or } Q\,P = C\,b + (Q - C)\,b',$$

and

$$Q\,F = C\,a + Wh\,a', \text{ or } Q\,F = C\,a + (Q - C)\,a',$$

and therefore

$$C\,b - C\,b' = Q\,P - Q\,b', \text{ or } C\,(b - b') = Q\,(P - b');$$

and

$$C\,a - C\,a' = Q\,F - Q\,a', \text{ or } C\,(a - a') = Q\,(F - a');$$

whence

[50] $$C = \frac{Q\,(P - b')}{b - b'},$$

[51] $$C = \frac{Q\,(F - a')}{a - a'}.$$

One or other of these formulæ may be used according as a definite fat or proteid percentage is desired. The constants a, a' represent the fat percentages of the cream and the whey, and b, b' represent the corresponding proteid percentages. Thus, for 20 per cent. cream (F 20, P 3.20, S 3.80) and whey (F 0.32, P 0.86, S 4.8) the formulæ would become

[52] $$C = \frac{Q\,(P - 0.86)}{3.20 - 0.86} = \frac{Q\,(P - 0.86)}{2.34}$$

and

[53] $$C = \frac{Q\,(F - 0.32)}{20 - 0.32} = \frac{Q\,(F - 0.32)}{19.68}.$$

The formula for L can be derived from the general formula [7] by substitution, which gives

[54] $$L = \frac{Q\,S - (4.8\,Wh + 3.8\,C)}{100}.$$

So, in the same way for 16 per cent. cream, the formulæ become, after substitution:

[55] $$C = \frac{Q\,(P - 0.86)}{2.74},$$

[56] $$C = \frac{Q\,(F - 0.32)}{15.68}.$$

For 12 per cent. cream:

[57] $$C = \frac{Q\,(P - 0.86)}{2.94},$$

[58] $$C = \frac{Q\,(F - 0.32)}{11.68}.$$

For 8 per cent. cream:

[59] $$C = \frac{Q(P - 0.86)}{3.04},$$

[60] $$C = \frac{Q(F - 0.32)}{7.68}.$$

The following table gives the varying combinations of fat and proteids that can be obtained by mixtures of whey and cream of various fat percentages. For the sake of comparison the quantities of cream required for a mixture of twenty ounces have been worked out and are given in the final column:

WHEY AND CREAM MIXTURES.

To be made by diluting cream with weak-fat whey.

With 20 per cent. Cream.		Cream in Twenty-ounce Mixture, with Whey.
For 1.00 F.	P = 0.94	0.70 ounce.
For 2.00 F.	P = 1.06	1.71 ounces.
For 3.00 F.	P = 1.18	2.72 ounces.
For 4.00 F.	P = 1.30	3.74 ounces.
With 16 per cent. Cream.		
For 1.00 F.	P = 0.98	0.87 ounce.
For 2.00 F.	P = 1.15	2.14 ounces.
For 3.00 F.	P = 1.32	3.42 ounces.
For 4.00 F.	P = 1.50	4.69 ounces.
With 12 per cent. Cream.		
For 1.00 F.	P = 1.03	1.16 ounces.
For 2.00 F.	P = 1.28	2.88 ounces.
For 3.00 F.	P = 1.53	4.59 ounces.
For 4.00 F.	P = 1.79	6.30 ounces.
With 8 per cent. Cream.		
For 1.00 F.	P = 1.13	1.77 ounces.
For 2.00 F.	P = 1.53	4.38 ounces.
For 3.00 F.	P = 1.92	6.98 ounces.
For 4.00 F.	P = 2.32	9.58 ounces.
With 4 per cent. Cream (Milk).		
For 1.00 F.	P = 1.44	3.69 ounces.
For 2.00 F.	P = 2.29	9.13 ounces.
For 3.00 F.	P = 3.15	14.56 ounces.
For 4.00 F.	P = 4.00	20.00 ounces.

By reference to this table it is easy to select the strength of cream which gives a satisfactory proteid percentage for the fat percentage desired. Since, however, with the richer creams the small quantities used contribute a low percentage of caseinogen to the total mixture, there is not the same urgent necessity for controlling the general proteid percentage as there is in the ordinary milk and cream combinations. The calculation of the amount of sugar of milk to be added can be made by substitution in formula [7].

PART III.

GENERAL CONSIDERATIONS OF SUBSTITUTE FEEDING.

COMPARATIVE analyses show that cows' milk contains at least twice as much of the proteids as does human milk; and that of the two principal albuminoid bodies, caseinogen and lactalbumin, the relative proportions in cows' milk are approximately as five and a half to one, while in human milk the lactalbumin is about twice the caseinogen. Koenig's analyses give the following comparison between the albuminoids of the two:

	Cows' Milk.	Human Milk.
Caseinogen	2.88	0.59
Lactalbumin	0.53	1.23
Total proteids	3.41	1.82

It therefore seems that the actual percentage of lactalbumin in human milk is more than twice that of cows' milk, while its caseinogen is just about one-fifth. The large relative proportion of lactalbumin in the proteids of human milk would naturally suggest that this organic component is much more important in the nutritive processes of the nursing infant than is the caseinogen. Whether or not this be true, the effect of diluting cows' milk, to bring down the total proteids to a percentage approaching that of human milk, is to reduce the percentage of lactalbumin very considerably below that which exists in the human secretion. By referring to the table above given it will be seen that a dilution of cows' milk with an equal quantity of water would yield a mixture containing 1.44 per cent. caseinogen, two and a half times that of

human milk, with only 0.265 per cent. lactalbumin, or about one-fifth of what nature provides in an equal quantity of human milk. Our imitative mixture thus contains a marked deficiency in the easily assimilable lactalbumin and an excess of the less readily digestible caseinogen. If it were possible by means of simple dilution so to modify cows' milk as to obtain the same proportion of lactalbumin as is presented in human milk, at the same time reducing the caseinogen to a correspondingly low percentage, such a mixture ought to form a perfect substitute for mother's milk during the whole period of natural lactation. This restriction in the modification of the proteids, therefore, would seem to explain why a mixture imitating in its gross percentages the analysis of human milk fails to offer a satisfactory substitute food during the later months of the period of artificial lactation. Clinical observation shows that as the end of the first year is approached increasingly larger proportions of the proteids must be given until, at about the time of natural weaning, the infant demands and is able to appropriate a proportion of total proteids far in excess of that which he would obtain in a mixture more closely corresponding with the composition of breast-milk; but even with such a degree of concentration the percentage of lactalbumin is still far below that present in the mother's secretion.

Digestive Equilibrium.—While it is quite certain that caseinogen, provided it be digested, can to a considerable degree take the place of lactalbumin in the processes of nutrition, the conclusion is logical that, in order to nourish sufficiently the young infant artificially, we are obliged to run perilously close to the point of overtaxing its digestion by the unnatural excess of caseinogen that must be given. Thus each infant seems to have at any given stage of the first nutritive period a certain state of digestive equilibrium which can be measured by the feeding formula which furnishes a food that is perfectly acceptable to its digestion and upon which normal gain in weight is made.

The reasonableness of this hypothesis is shown very frequently in percentage feeding; for example, a delicate nine months' old baby, gaining rapidly upon a percentage formula containing 1.90 proteids, repeatedly showed signs of indigestion with a stand-still in weight when the percentage was increased to 1.93 by adding only two teaspoonfuls of milk to the fourteen ounces already used

in a total mixture of thirty-six ounces. (See Case III., p. 287.)

In other words, digestive equilibrium was maintained by a proteid percentage not exceeding 1.90, but was disturbed as soon as the proportion of proteids was advanced to 1.93 per cent. To apportion this percentage of total proteids into the percentages of caseinogen and lactalbumin, it will be found that about 1.60 per cent. of the mixture was caseinogen, while only 0.30 per cent. was lactalbumin. The child was therefore taking and digesting nearly three times as much caseinogen as nature provides in the mother's milk, with only one-fourth of the normal quantity of lactalbumin. With this child, therefore, digestive equilibrium was disturbed by increasing the caseinogen percentage above 1.60, and thus, for the time being, this proportion or percentage of caseinogen should be considered the highest measure of this infant's casein digestion, beyond which nothing could be gained by trying to force the caseinogen percentage (and therefore the total proteid percentage) until the digestive powers had become stronger.

The first rule in artificial feeding, therefore, is to begin with a mixture which is well within the digestive powers of the baby. And at the first step it is safer to prescribe a formula that is too weak than one that is too strong, for it is always easy to advance to higher percentages after the child's digestive factor, so to speak, has been determined, while progress will be slower when this has been at the start gauged too high.

It is only when this state of equilibrium between digestive power and the food has been attained that satisfactory increase in weight can be made. This fact is well illustrated by the rapid gains made by Case II. (see page 285) after the initial reduction of the proteid percentage from 1.82 to 1.56, the formula in other respects remaining practically the same as before.

The Living Ration of Milk Solids per Day.—Pfeiffer's analyses ("66° Réunion de Naturalistes et de Médecins allemandes," Vienna, 1894) have shown that between the fourth and fifth month the breast-fed baby takes daily about a litre of milk, which contains about fifteen grammes of total proteids. Since, according to our standard percentages, a litre of a mixture of cows' milk and enough cream to make up for the deficiency of fat caused by the dilution of an average percentage formula would contain about thirty-eight

grammes of proteids, it is evident that about three hundred and ninety-four cubic centimetres (twelve and eight-tenths ounces) of cows' milk and cream would be required to furnish an amount of proteids equal to the daily ration of this element in the breast-milk. This theoretical conclusion coincides exactly with the writer's clinical observation in feeding with low proteid percentage mixtures,—namely, that until the quantity of milk and cream combined reaches about twelve or thirteen ounces in a mixture of from thirty to thirty-two ounces, or a like proportion for other quantities of mixture, satisfactory growth and nutrition cannot be expected. The administration of dilutions of mixed milk and cream weaker than twelve parts in thirty (one in two and a half) must therefore be considered as underfeeding. To translate this into a percentage form, it may be said that upon both theoretical and clinical grounds a percentage of proteids below 1.50 must be considered subnormal for any but the youngest infant, and therefore when low feeding must be maintained for a considerable time this percentage should be kept constantly in mind as the index of the concentration it is desirable to reach as soon as the strength of the infant's digestion will permit.

In the same way it can be shown from Pfeiffer's analyses that about thirty-six grammes of fat in the litre of breast-milk are required by a four or five months' old baby. This is the equivalent of 3.6 per cent. fat, a proportion which conforms to the rule practised in percentage feeding; a sugar percentage of about 6.50 to 7 can be derived in the same way. We are therefore prepared to accept the following rules regarding the percentages of fat, proteids, and sugar to be used in prescription writing.

The Fat Percentages.—As a rule, the percentage of fat should rarely exceed 4, and in the earlier months of life a percentage nearer 3 will be found to give more satisfactory results. In rare cases of delicate, though not necessarily diseased, digestion, a percentage of fat lower than 3 may for a time be better borne; but ordinarily a healthy child after the first month or six weeks of life can readily appropriate a mixture containing 3 per cent. of fat. A good working rule is to make the fat percentage about 3 when the proteid percentage is 1, and gradually to increase it to 4, while the proteid percentage is increased to 2. As can be seen by formulæ [*39*] and [*40*], when the mixture is enriched by a gradual increase in the

quantity of milk the percentages of fat and proteids increase by equal increments. Therefore, if the initial formula is made F. 3-P. 1 and a gradual increase of the quantity of milk is made, the total quantity of mixture at the same time remaining constant, the fat percentage becomes 4 when the proteid percentage reaches 2. From this point onward the quantity of cream will gradually be reduced while the quantity of milk increases, until the former reaches the vanishing point, when the rest of the mixture is composed entirely of milk, the diluent then being no longer required. The formula then stands F. 4-P. 4,—the formula of whole milk.

The Proteid Percentages.—It has been shown that the proper regulation of the proteid percentage is the most difficult part of the whole subject of milk feeding. It must be admitted that in very rare instances cases are encountered in which the administration of milk in any form of modification is badly borne and occasionally is impossible. Infants are frequently seen, however (in whom this history is given with almost convincing sincerity by the mother), who can readily be made to digest and thrive upon a milk mixture after many previous attempts and failures have been recorded. In almost every instance the fault lies in unskilful management of the proteids. A baby two or three months of age may show all the popularly understood symptoms of being unable to digest or thrive upon a half milk and half water mixture which contains about 2 per cent. proteids, but will improve at once and thrive when the percentage of proteids—largely caseinogen—is reduced to 1.50, 1.25, 1, or even lower. It is often necessary for a time to reduce the proteids below 1 per cent. in order to establish digestive equilibrium. Since, however, a proteid percentage less than 1 means a dilution greater than one part of milk to three parts of water, it will readily be seen, from what has already been said, that the total quantity of milk solids that can be given for the day's feeding is considerably below a fair living ration and, while supporting life for a time, can scarcely be expected to produce an appreciable upward trend of the weight-curve. Under these conditions the use of the lactalbumin proteids from whey will enable the baby to appropriate a larger proportion of the more assimilable lactalbumin and perhaps a higher percentage of total proteids than any other plan of feeding. For this purpose, in preparing the whey, the curd, after forming, should be disturbed

as little as possible, the whey being allowed to drain off entirely by gravity. The object of this precaution is to obtain as low a percentage of fat as possible, since the mixture will now become essentially a cream dilution and nearly all of the fat will be derived from the cream.

For example, 20 ounces of a 3 F.-1.25 P. mixture of 12 per cent. cream and weak whey will be made according to formulæ [*47*] and [*48*] by using four and eight-tenths ounces of cream and seven and a half ounces of whey, the rest of the twenty ounces being made up with water. The percentage of lactalbumin-proteid contributed by the whey in this mixture is about 0.32, a considerably higher proportion of this body than could be obtained in an ordinary cream or cream and milk dilution giving the same percentage of total proteids. The advantage of such a modification for cases of delicate digestion in which low proteids are indicated will readily be appreciated.

In some cases of extreme intolerance of the digestion for casein the whole quantity of the diluent may be made of weak whey, the necessary amount of fat (and an additional small percentage of mixed proteids) being contributed by a rather rich cream. Thus, in the mixture just illustrated, if four and eight-tenths ounces of 12 per cent. cream be taken and diluted up to twenty ounces with whey (fifteen and two-tenths ounces), the fat percentage will be 3.12 and the proteids 1.57, of which latter there will be fully 0.80 lactalbumin with only 0.77 caseinogen. With a richer cream the proportion of caseinogen would still further be reduced.

As already suggested, the increase of the proteid percentage should be rather slow, keeping pace with, but somewhat behind, the improvement in the strength of the casein digestion. In this respect each infant establishes his own law of progress, which is the more rapid as general strength increases and the digestive organs are permitted to suffer no unnecessary tax.

In a general way it may be said that in normal cases a proteid percentage of 2 should not be reached before the fifth or sixth month. For cases of chronic digestive disease it may be several months later before so high a percentage can be attained, and even in cases of delicate digestion it may not be possible to push the percentage above 2 until near the end of the first year. This was

the case with the baby whose history is given under Case III. (see p. 287).

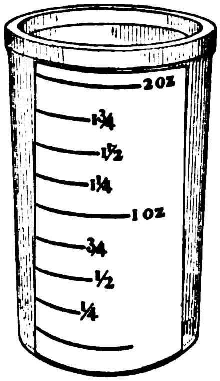
The Sugar Percentages.—As a rule, the management of the sugar percentages gives little difficulty. Since human milk contains from 6.50 to 7 per cent. of lactose, a corresponding percentage may be given in the mixture, except in the earliest days of life, when a percentage of 4.50, 5, or 5.50 would be more suitable. The necessary amount of dry sugar of milk to be added to the mixture can be calculated by formula [*15*] or [*22*]. Care should be exercised to obtain a perfectly pure preparation, since much of the milk sugar of commerce is dirty and is often contaminated with milk bacteria. The purest form is finely crystalline in structure, and this should be preferred to the ordinary powdered sugar, which can readily be adulterated. It is preferable to add the necessary weight of sugar in dry form rather than to use a watery solution of definite percentage strength. Milk-sugar is readily soluble, and can be added to the requisite quantity of water just before the materials are combined.

The required weight of milk-sugar for the total day's feeding may be ordered in packets from the druggist, or, what is a more economical plan, a single powder of the desired weight may be obtained and this used for a measure. This quantity can be measured into a pasteboard powder-box, which can then be marked at the upper level with an ink line or trimmed down with a sharp knife so as to constitute an accurate measure for future use. The writer has adopted a convenient-sized glass jar, which is sold by one of the large grocery stores of Philadelphia, and has worked out a graduated scale, in ounces and fractions, which he has had duplicated by printing for the use of his patients. This serves the purpose excellently, and enables the mother to make a sugar measure by pasting the scale on the outside of the jar and covering it with a film of varnish. In using this measure the sugar is filled in lightly to a little above the mark indicating the weight desired and the surface is levelled by lightly tapping the bottom of the measure two or three times upon the table. More frequent tapping will result in packing down the sugar too closely and thus giving an overweight. (Fig. 1.)

Diluents.—The diluent regularly employed in laboratory modification, and usually in home modification, is distilled water.

Other fluids, however, may be used according to the physician's individual preference. Barley-water has long held a favored place as a milk diluent, and oatmeal-water or rice-water may at times be employed, the usual rule of choice being to use barley-water

FIG. 1.



Author's sugar measure.

when there is a tendency to looseness of the bowels, oatmeal-water when constipation is the rule, and rice-water when the condition of the bowels is normal.

Alkalinity.—It has been customary to add lime-water to milk mixtures for the purpose of preventing rapid coagulation of curd in the stomach or of enabling the milk to pass in great part unchanged into the intestine. In the laboratory modifications lime-water is used to change the reaction of the milk from acid to alkaline in imitation of the normal alkaline reaction of human milk. According to Hammarsten,[1] the beneficial results obtained by adding a small quantity of lime-water to milk probably do not come so much from such a feeble effort at neutralizing the acidity of the milk as by allowing the rennet to act to better advantage.

Dr. Rotch's experiments (*Pediatrics,* p. 236) with various proportions of lime-water added to milk twenty-four hours old have shown that 6.25 per cent. lime-water in such a mixture is sufficient to render the reaction slightly but distinctly alkaline and

[1] A Text-Book of Physiological Chemistry; American edition, New York, 1897.

corresponding to that of human milk. With a fresh and carefully garnered milk, such as is now easily obtainable for infant feeding, the proportion of lime-water required to produce the same degree of alkalinity would be still less than this, probably about 5 per cent., or one-twentieth of the volume.

To carry out this principle to a logical conclusion for percentage mixtures the quantity of lime-water required to produce the desired alkalinity should be one-twentieth of the combined quantities of the milk and cream plus a slight excess to alkalize to the same degree the supplementary quantity of water, which is, of course, neutral in reaction.

Whatever the theory of its action, lime-water is often an unnecessary addition to the mixture, and in infants disposed to constipation, as many bottle-fed babies are, its astringent effect may be especially undesirable. When, however, its use seems demanded by an irritable stomach it may be added in the proportion of from 5 to 10 per cent.,—that is, from one-twentieth to one-tenth of the total quantity of mixture. When desired for this indication better results may often be obtained by using the lime-water in combination with an aromatic water (like cinnamon-water) in doses of about half a teaspoonful of each mixed, just before giving the bottle.

Alkalinity of the mixture may also be obtained by the use of sodium bicarbonate in the dose of from two to four grains to the bottle, or of saccharated solution of lime, from five to fifteen drops (Starr).

Partial Predigestion.—In cases of weak gastric or intestinal digestion in which only very low percentages of proteids can be assimilated, decided advantage is often gained by partial predigestion of the milk mixture. In this way, too, higher percentages of proteids can be given than is possible with simple dilutions. Partial predigestion or peptonization is accomplished by the action of pancreatin in the presence of an alkali, usually sodium bicarbonate, in the proportions of five grains of pancreatin and fifteen grains of sodium bicarbonate to the pint of milk diluted with one-fourth its bulk of water, the degree of peptonization depending upon the length of time during which the ferment is allowed to act at a temperature of from 105° to 110° F. Further digestive action can be prevented by rapid cooling to the ordinary tempera-

ture of the ice-chest, or by raising the mixture to a temperature of 170° F., at which the ferment is destroyed. In practical work the writer has obtained more satisfactory results from the use of the peptogenic milk powder. This preparation contains pancreatin, sugar of milk, and alkaline milk salts. With ordinary percentage mixtures this powder may be used in the proportion of one level teaspoonful to two and a half ounces of mixed milk and cream. The necessary quantity is added after the mixture in the bottle has been warmed to a temperature of 105° F., and this temperature is maintained for from six to eight minutes, after which the mixture is cooled in the air until of the proper temperature for feeding (from 95° to 98° F.). Ordinarily it is preferable to predigest the entire mixture for the day's feeding at the time of combining the ingredients. The mixture is raised to 105° F., the necessary quantity of powder is then added, and the temperature is maintained at about the same height for eight, ten, or twelve minutes, according to the degree of predigestion desired. An additional strength of heat is now applied and the temperature is rapidly raised to 170° F., or, if preferred, just to the point of beginning ebullition, after which rapid cooling is effected. Since a large proportion of the powder consists of milk-sugar, the writer directs that the bulk of the powder be deducted from the quantity of milk-sugar to be added to bring up the mixture to the desired sugar percentage. If the sugar measure described on page 269 be used, the peptogenic powder is first measured into the glass and then milk-sugar is added to bring up to the calculated weight of milk-sugar. The contents of the glass are then to be added to the mixture of cream, milk, and water after the initial heating to 105° F., and the process of peptonization is carried out as indicated above.

Contrary to a very commonly expressed opinion, the writer has never had occasion to observe the often-described ill effects of a partially peptonized diet, although this mode of preparation has been employed in many cases that demanded it for from three to six months or even longer.

It is usually best to discontinue partial predigestion slowly, reducing, first, the time of action gradually to three or four minutes, and then decreasing the quantity of powder to a third or fourth of the original quantity used, after which it may be omitted.

Theoretical Scheme of the Percentages for a Healthy Infant.—The experience of a large number of physicians in feeding healthy infants upon laboratory milk has established a certain average of percentages for each week of the first year, which has been expressed in the following tables:

Table showing the Average Percentages employed, and the Amount of Modified Milk fed to a Large Number of Infants.—(Walker-Gordon Laboratory.)

Weeks of Life.	Amt. fed in ozs.	Percentages.		
		Fat.	Sugar.	Proteids.
First	1¼	2.00	4.50	0.75
Second	1¾	2.50	5.50	1.00
Third	2	3.00	6.00	1.00
Fourth	2¼	3.00	6.00	1.00
Fifth	2¾	3.25	6.50	1.00
Sixth	3	3.25	6.50	1.25
Seventh	3	3.50	6.50	1.25
Eighth	3¼	3.50	6.50	1.25
Ninth	3½	3.50	6.50	1.25
Tenth	3½	3.50	6.50	1.25
Eleventh	3½	3.50	6.50	1.25
Twelfth	3¾	3.50	6.50	1.25
Thirteenth	3¾	3.50	6.50	1.25
Fourteenth	4	3.50	6.50	1.25
Fifteenth	4¼	3.75	6.50	1.25
Sixteenth	4¼	3.75	6.50	1.25
Seventeenth	4½	3.75	6.50	1.50
Eighteenth	4½	3.75	6.50	1.50
Nineteenth	4¾	3.75	6.50	1.50
Twentieth	4¾	3.75	6.50	1.50
Twenty-first	4¾	3.75	6.50	1.50
Twenty-second	5	3.75	6.50	1.50
Twenty-third	5	3.75	6.50	1.50
Twenty-fourth	5¼	3.75	6.50	1.75
Twenty-fifth	5¼	3.75	6.50	1.75
Twenty-sixth	5½	3.75	6.50	1.75
Twenty-seventh	5½	4.00	6.50	1.75
Twenty-eighth	5½	4.00	7.00	1.75
Twenty-ninth	5¾	4.00	7.00	1.75
Thirtieth	5¾	4.00	7.00	1.75
Thirty-first	6	4.00	7.00	1.75
Thirty-second	6	4.00	7.00	1.75
Thirty-third	6¼	4.00	6.50	1.75
Thirty-fourth	6¼	4.00	6.50	2.00
Thirty-fifth	6¼	4.00	6.50	2.00
Thirty-sixth	6¼	4.00	6.50	2.00
Thirty-seventh	6½	4.00	6.50	2.00
Thirty-eighth	6½	4.00	6.50	2.00
Thirty-ninth	6½	4.00	6.50	2.00
Fortieth	6¾	4.00	6.50	2.00
Forty-first	6¾	4.00	6.50	2.00
Forty-second	7	4.00	6.50	2.00
Forty-third	7	4.00	6.50	2.25
Forty-fourth	7	4.00	6.00	2.50
Forty-fifth	7	4.00	6.00	2.50
Forty-sixth	7¼	4.00	6.00	2.50
Forty-seventh	7¼	4.00	6.00	2.50
Forty-eighth	7¼	4.00	6.00	2.50
Forty-ninth	7¼	4.00	6.00	2.75
Fiftieth	7¼	4.00	6.00	2.75
Fifty-first	7¼	4.00	6.00	2.75
Fifty-second	7¼	4.00	5.50	3.00

Premature Infants.

Amount Fed.	Fat.	Sugar.	Proteids.
2-6 drachms	1.00	3.00	0.25
	1.00	4.00	0.50
	1.50	4.50	0.75

The percentages are given in the round numbers next nearest the actual percentages employed, and are approximate.

As has been shown, this can be taken only as a guide. In many cases much weaker mixtures than indicated in the table will be required in the earlier months, even when the food is partially peptonized; and at the other end of the scale undiluted milk may not be tolerated by even healthy infants till well along into the second year.

Special Indications for modifying the Percentages.—After a

definite formula has been decided upon and the mixture given for a week it will be possible to judge of its value in the particular case. The weight should carefully be determined before the baby begins to take the new mixture, and a systematic record of the weight at the end of each week should be kept upon a chart. Under satisfactory conditions a weekly gain of from six to eight ounces should be made until the fifth or sixth month; after that the gain will be somewhat slower; but, apart from accidental digestive trouble, intercurrent disease, or the nutritive disturbances often accompanying the eruption of the teeth, the weekly gain in weight should average about four ounces from this period up to the end of the first year.

If the infant fails to gain satisfactorily from week to week, in the absence of obvious causes, the integrity of the digestion should first be investigated.

If there is no regurgitation, if the baby is comfortable and happy after the bottle, if the intestinal digestion is satisfactory, as shown by color and consistency of the passages, which should be free from cheesy curds and unmixed with any appreciable amount of mucus, it is reasonable to conclude that an increased concentration of the milk mixture is desirable. Under these conditions an advance in all the percentages may be made with benefit, especially in that of the proteids, since the fat and sugar percentages are usually nearer to the normal figures than is that of the proteids.

On the other hand, habitual distress after feeding, usually associated with colic or the grosser evidences of intestinal indigestion, is an indication for a reduction in the proteid percentage. In this connection it is well to refer to the small quantity of air which is usually swallowed with the feeding, to which the term "bottle-wind" may be applied. This petty annoyance often causes considerable distress until relieved by belching, and the nurse soon learns to raise the baby to a sitting posture after the bottle is emptied in order to favor the expulsion of this gas. If the baby be left in the supine position a mouthful of milk is often regurgitated with the "bottle-wind." Since the relief of discomfort is immediate upon the belching up of the "bottle-wind," there is little chance of mistaking the distress caused by it for a more serious digestive disturbance.

Vomiting soon after feeding is an evidence either of too large

a quantity for the capacity of the stomach or of a condition of chronic irritation of its mucous membrane. In either case the indication is to reduce the amount of the mixture given at a feeding, and when catarrhal irritation exists the proteid percentage should also be decreased. If, on the other hand, late regurgitation of sour-smelling masses of curd is of frequent occurrence, it is usually an indication of too high a percentage of fat, and calls for the reduction of this element of the formula. Too high a proteid percentage may also produce late vomiting. In this case, however, the vomited matter is more apt to show distinctly cheesy curds. Under these circumstances a reduction in both fat and proteids would be a safer procedure, for a time at least.

Obstinate constipation, when dependent upon food conditions and not upon congenital anatomical abnormalities in the size or course of the colon, or upon chronic intestinal catarrh, is usually caused by a deficiency of fat associated with a lack of sufficient bulk in intestinal contents, due to low proteids. In this case the percentage of both fat and proteids should be increased, according to toleration.

Unusual Conditions determining Loss of Weight or Failure to gain Satisfactorily.—Even under the best hygienic conditions, with a percentage mixture that has already produced normal gains in weight, it will occasionally happen that the child ceases to gain satisfactorily, stands still, or even loses weight, and this without any distinct disturbance in the regularity, frequency, or naked-eye appearance of the stools, and without other evidences of disturbance of digestion.

Anæmia, loss of strength and activity, may also be noted, and thus grave fears of serious organic disease may be aroused in the minds of both parents and medical attendant. In the absence of any pointings in the physical examination, attention should at once be directed to the milk from which the food mixture is prepared, and a rigid microscopical and bacteriological examination should be demanded. Even in the best-regulated dairies contamination of the milk with pus and pus organisms from suppurative affections of the udder of one or more cows may occur and for a time escape detection. The use of such infected milk for infant feeding may be followed by just such obscure symptoms as are above described.

Another cause of unsatisfactory progress in otherwise healthy infants should be emphasized. This is the practice, indulged in by lazy parents, of heating the last night bottle before retiring, and keeping it warm in a cozy or in the bed itself for three or four hours until it is required for use. Such a practice is well calculated to undo all the good results of careful handling of the milk during the day. The rapid multiplication of the milk bacteria under this culture process can most positively be expected. The following experiments, carried out by Dr. A. C. Abbott, of the University of Pennsylvania, under conditions imitating those that obtain in the household, show most conclusively the dangers that attend this mode of handling the feeding bottle.

A feeding mixture partially peptonized at the time of its combination and pasteurized by raising to 170° F. was used in the investigation. A count of the colonies of bacteria was made just after the peptonizing process was completed, and the sealed bottle, after cooling in the refrigerator, was then placed within a tea-cozy in contact with a hot-water bag the temperature of which was about 115° F. At the end of three hours another count was made, the milk being still warm enough to feed to a baby. The following table shows the means of duplicate results obtained on different culture media:

	After Peptonization.	After Three Hours at 115° F.
April 28	685	263,010
May 7	39,435	128,347
May 10	37,237	14,822
May 19	143,738	1,559,375
May 21	14,500	62,634
May 20	20,322	1,357
May 22	17,632	12,545
May 26	67,236	1,593,218

It will be noticed that in all but three of the experiments the increase in the number of bacteria after three hours' exposure to heat within the cozy was very striking. The fact that in three instances the number of bacteria after the heating was distinctly less than before can be explained, in Dr. Abbott's opinion, only by assuming that in these samples the majority of micro-organisms were not spore-forming bacteria, and that a great many were therefore killed at the temperature to which the milk was subjected in checking peptonization,—that is, 170° F. It is quite probable that with

raw milk treated in the same way the increase in bacteria would be very much more marked. Further experiments to determine this are at present being carried out.

Simple Clinical Methods of Milk Analysis.—It is frequently important to know the exact percentages of milk solids that occur in a given specimen of breast-milk, in order either to make an imitative mixture or to correct deficiencies or divergences of percentages by treatment of the mother. In the absence of facilities for intricate laboratory analysis very satisfactory results may be obtained by the physician himself by means of the Woodward method for the estimation of breast-milk proteids and the Leffmann-Beam method for the estimation of fat.

Estimation of Breast-Milk Proteids.—Dr. George Woodward, of Philadelphia (*The Philadelphia Medical Journal,* May 21, 1898), has proposed a simple clinical method of estimating the breast-milk proteids, which gives results very closely in accord with those obtained by the Kjeldahl method.

The test requires two specially constructed burettes of ten cubic centimetres' capacity, having a glass pinch-cock or valve and a narrow exit tube about one inch long. Each burette is charged with five cubic centimetres of the milk to be examined, and is subjected to a temperature warm enough to produce rapid souring (from 95° to 100° F.), in which it is allowed to remain until a distinct precipitation can be seen. The necessary temperature can conveniently be obtained by placing the tubes in a burette-stand and the stand in contact with a radiator or steam-pipe leading to a radiator. The time required to obtain a distinct precipitation of casein is from eighteen to twenty-four hours. At the end of this time the milk has distinctly separated into an upper layer of viscid yellow fat and a lower layer of fluid milk, quite opaque above, almost translucent below, and clinging to the sides of the tube and especially at the bottom, a granular precipitate. The burettes are now cooled in water, which increases the viscidity of the fat and facilitates its separation from the milk serum. The latter is drawn off from below into fifteen-cubic-centimetre graduated tubes, and Esbach's solution (picric acid, five grammes; citric acid, ten grammes; water, 500 cubic centimetres) added to the fifteen-cubic-centimetre mark. The mixture is then stirred with a glass rod and the tubes are placed in the centrifuge. The tubes are then whirled until a

constant reading is obtained, and this expresses in percentage the amount of total proteids in the milk. The amount of centrifugation required is in direct proportion to the care used in separating the fat. If fermentation be watched and the separation made as soon as the casein precipitate is distinctly present, the centrifugation to a constant reading can quickly be accomplished.

Estimation of the Fat.—The method employed for the quantitative analysis of the fat of either human or cows' milk is a modification of the well-known procedure of Leffmann and Beam. For this purpose a specially constructed graduated milk bottle is used, which will fit in any medical centrifuge. The sample of milk should be taken from the middle of the nursing or milking, as representing the average richness of the milk. Five cubic centimetres of the sample are introduced into the milk bottle by means of a special milk pipette and one cubic centimetre of Reagent No. 1 [1] is added and shaken by hand. Then by means of the large pipette Reagent No. 2 [2] is added little by little, with shaking, until the bottle is filled to the base of the graduated neck. A mixture of equal parts of sulphuric acid and water is then added to reach a little above the first graduation mark. The bottle is next placed in the centrifuge and whirled for two minutes, when the fat will be found to have risen in a clear yellowish layer which can be read in percentages by means of the scale engraved on the neck of the bottle. If the milk should be richer than 5 per cent., dilute a portion of it with an equal quantity of water and use this as above indicated, multiplying the final result by two. For cream add twenty cubic centimetres of water to five cubic centimetres of the cream and mix thoroughly. Take five cubic centimetres of this mixture for analysis and multiply the final result by five.

PART IV.

PRACTICAL APPLICATION OF PERCENTAGE FEEDING.

Feeding from Birth.—If an infant born with normal digestive powers and deprived early of its mother's milk be started properly

[1] Reagent No. 1 consists of fusel oil, thirty-seven parts by volume; wood alcohol, thirteen parts; hydrochloric acid, fifty parts.

[2] Reagent No. 2 consists of sulphuric acid, specific gravity 1.832.

upon an appropriate bottle mixture, the problem of arranging its feeding is comparatively a simple one. For the first seven to ten days a weak cream and whey mixture will usually be acceptable. The quantity should be about an ounce, and should be given every two hours, except during the night, when two feedings can generally be omitted. A one in five dilution of 12 per cent. cream would yield a mixture giving F. = 2.40, P. = 0.76, S. = 0.84. The substitution of a fluidrachm of whey for a fluidrachm of the diluent in each fluidounce of this mixture would add about 0.10 per cent. lactalbumin to the proteids, 0.04 per cent. to the fat, and 0.60 per cent. to the sugar, thus giving a total of F. = 2.44, P. = 0.86, S. = 1.44. The deficiency of sugar could be made up to about 5 per cent. by the addition of some fifteen grains of dry sugar of milk to each bottle.

Such a mixture as this will serve excellently as a foundation upon which to build the subsequent formulæ. In making an increase one of two procedures may be adopted: either to increase the percentages numerically and then calculate the corresponding quantities of milk, cream, and sugar to be used, or to increase the strength of the mixture by adding a certain definite quantity of milk, but keeping the total quantity of mixture unchanged. If the latter plan be adopted, formulæ [*39*], [*40*], and [*42*] can be used to keep the percentage formula under control. Of these two methods I much prefer the latter, since it permits the quantity of cream to remain constant for a considerable time, and thus adds greatly to simplicity in preparing the food. By reference to formulæ [*39*], [*40*], [*41*], and [*42*] it will be observed that the percentages of fat and proteids contributed by the milk are exactly equal, and that the percentage of sugar is only a trifle greater than these. It is therefore evident that, starting from a definite percentage formula, such as that already given for the cream dilution (F. = 2.40, P. = 0.76, S. = 5), and increasing the quantity of milk only, an increase of 0.10 per cent. in the proteids is accompanied by an increase of 0.10 per cent. of fat and 0.11 per cent. of sugar. In practice it is simpler to add one or two fluidrachms of milk, subtracting the same amount from the diluent. For example, take the formula above suggested, with a total of fifteen ounces for the day's feeding. The prescription for the mother will be as follows:

Cream (12 per cent.)	3 ounces	F. = 2.40
Water or barley-water	12 ounces	P. = 0.76
Sugar of milk (dry)	⅝ ounce	S. = 5.00

The addition of two fluidrachms of milk in the total mixture would give

Cream (12 per cent.)	3 ounces	F. = 2.467
Milk	2 fluidrachms	P. = 0.827
Water or barley-water	11 ounces, 6 fluidrachms	S. = 5.073
Sugar of milk	⅝ ounce	

The addition of two fluidrachms more of milk would give

Cream (12 per cent.)	3 ounces	F. = 2.533
Milk	½ ounce	P. = 0.893
Water or barley-water	11½ ounces	S. = 5.147
Sugar of milk	⅝ ounce	

And thus by gradual steps the strength of the mixture in all of its percentages is increased by nearly equal increments. If at any time it seems desirable to increase one of the percentages more rapidly than the others, or to decrease any, recourse can be had to formulæ [*17*], [*19*], and [*22*], which, by a few minutes of calculation, will give the quantities corresponding to the desired percentages.

In normal cases the rapidity of increase must be determined by the conditions. Some infants could stand for a time an increase in proteids of 0.10 per cent. a week until about 1 per cent. is reached. This would occur in the above formula when between seven and eight drachms of milk were used. Thus,—

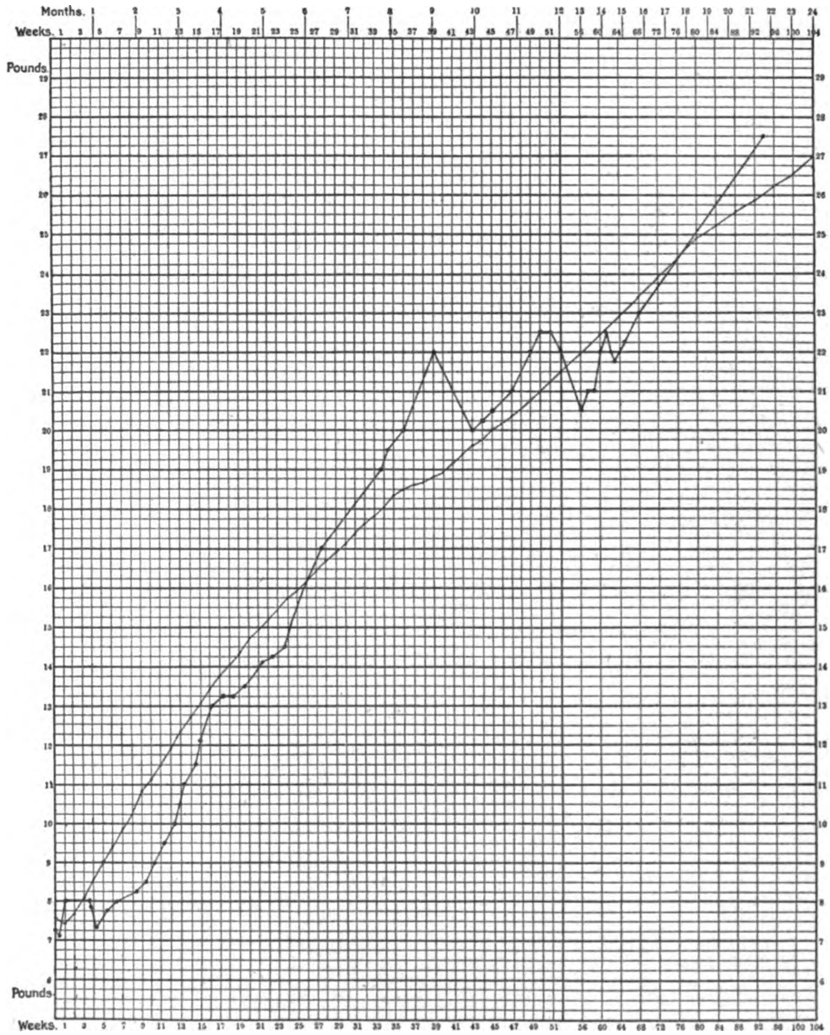
Cream (12 per cent.)	3 ounces	F. = 2.667
Milk	1 ounce	P. = 1.027
Diluent	11 ounces	
Sugar of milk	⅝ ounce	S. = 5.293

After reaching 1 per cent. of proteids the increase should be somewhat slower. It is now generally safer, before continuing to increase the percentages, to increase the quantity at a feeding, and consequently the actual amount of nourishment in the day's supply. The following case, the weight-curve of which is given in Fig. 2, illustrates the method of regulating the feeding in a normal case.

Case I.—Male infant, weighing at birth seven and one-quarter pounds. Nursed at the breast for two weeks, when, on account of

failure of the mother's milk, artificial feeding was begun, at first with condensed milk, one to sixteen, for the third week, and for the

FIG. 2.



Weight chart of Case I. The average weight of the breast-fed baby is indicated by the curved line.

fourth week with six parts of milk to five of barley-water (too high a proportion of milk). The weight at four weeks was eight pounds. At this time he passed through a severe attack of influenza, during

which life was frequently threatened by respiratory failure. Recovery, however, after several days, was rapid, and feeding was begun under my direction upon a mixture of one part ordinary cream (which contained 11 per cent. fat) to three parts barley-water, about two ounces of which were given for a feeding with the addition of fifty grains of sugar of milk to each bottle. The percentages represented by this mixture were approximately F. 2.75, P. 0.95, S. 6.20. This agreed well and the baby gained in weight. For convenience, a laboratory mixture of F. 3, P. 0.90, S. 6 was ordered, but it produced some disturbance of digestion. The household mixture was then resumed, and feeding continued with an approximately 12 per cent. cream and whole milk. After a few days a little milk was added, and this was gradually increased until at the age of eleven weeks, when he weighed nine and one-half pounds, a total quantity of thirty-three ounces for eleven feedings was ordered and the following formula was given: F. 3.32, P. 1.47, S. 5, which was represented by the prescription:

Cream (11 per cent.)	8¾ ounces	F. = 3.32
Milk	3¼ ounces	P. = 1.47
Barley-water	21 ounces	S. = 5.00
Sugar of milk	9½ drachms	

Twelve Weeks.—Has gained one-half pound, weighing ten pounds.

Thirteen Weeks.—Has been doing well. Has gained a full pound in past week, weighing eleven pounds. Formula changed to

Cream (11 per cent.)	9 ounces	F. = 3.45
Milk	3¾ ounces	P. = 1.49
Barley-water	20¼ ounces	
Sugar of milk	9½ drachms	S. = 5.25

Fourteen Weeks.—Weighs eleven and one-half pounds, a gain of one-half pound. To increase feeding to three and one-half ounces and interval to two and one-half hours, necessitating an increase of total quantity to thirty-five ounces:

Cream (11 per cent.)	9½ ounces	F. = 3.48
Milk	4¼ ounces	P. = 1.52
Barley-water	21¼ ounces	S. = 5.26
Sugar of milk	10½ drachms	

Fifteen Weeks.—Weighs twelve pounds three ounces, a gain of nearly three-quarters of a pound. Three and one-half ounces seem to be more than he can comfortably take at a feeding. Quantity is cut down to three ounces and the interval again made two hours.

Sixteen Weeks.—Weighs thirteen pounds, a gain of three-quarters of a pound.

Seventeen Weeks.—Weighs thirteen and one-quarter pounds, a gain of one-quarter of a pound. Bowels have been disturbed for several days, three or four stools a day. As this continued, it was decided to use laboratory milk and cream (12 per cent.) in a formula reducing the fat to about 3.36, but leaving proteids at 1.50. Thus,—

Cream (12 per cent.)	8 ounces	F. = 3.368
Milk	5½ ounces	P. = 1.497
Barley-water	21½ ounces	S. = 5.223
Sugar of milk	10 drachms	

After this the condition of the bowels improved, but no gain in weight was recorded at the end of the eighteenth week.

Nineteen Weeks.—Has gained one-quarter of a pound, weighing thirteen and one-half pounds.

Twenty Weeks.—Slight looseness of bowels for several days. Has gained only one-quarter of a pound, weighing thirteen and three-quarters pounds.

Twenty-one Weeks.—Weighs fourteen and one-eighth pounds, a gain of six ounces. Milk is now to be increased two fluidrachms every other day till it reaches

Cream (12 per cent.)	8 ounces	F. = 3.483
Milk	6½ ounces	P. = 1.611
Barley-water	20½ ounces	S. = 5.35
Sugar of milk	10 drachms	

Twenty-two Weeks.—Weighs fourteen and one-quarter pounds, a gain of one-eighth of a pound. Going away for the summer. Directions are given to raise a gravity cream of about 12 per cent. fat, and gradually to increase the quantity of milk up to seven and one-half ounces, which would give the following:

Cream	8 ounces	F. = 3.597
Milk	7½ ounces	P. = 1.725
Barley-water	19½ ounces	S. = 5.79
Sugar of milk	10 drachms	

Twenty-three Weeks.—Weighs fourteen and one-half pounds.

Twenty-four Weeks.—Has gained three-quarters of a pound, weighing fifteen and one-quarter pounds.

Twenty-five Weeks.—Has gained three-quarters of a pound, weighing sixteen pounds.

Twenty-seven Weeks.—Has gained one pound in two weeks, weighing seventeen pounds.

Twenty-eight Weeks.—Gaining. Has been disturbed by teething.

Thirty Weeks.—Total quantity to be increased to forty ounces and percentages to be raised a little:

Cream (12 per cent.)	9 ounces	F. = 3.85
Milk	11½ ounces	P. = 2.00
Water	19½ ounces	S. = 5.91
Sugar	1½ ounces	

Thirty-three Weeks.—Weighs nineteen pounds.

Thirty-four Weeks.—Weighs nineteen and one-half pounds.

Thirty-six Weeks.—Weighs twenty pounds.

Thirty-nine Weeks.—Weighs twenty-two pounds. Milk has been gradually increased to thirteen and one-half ounces, which gives a percentage formula of F. 4.05, P. 2.20, S. 6.13.

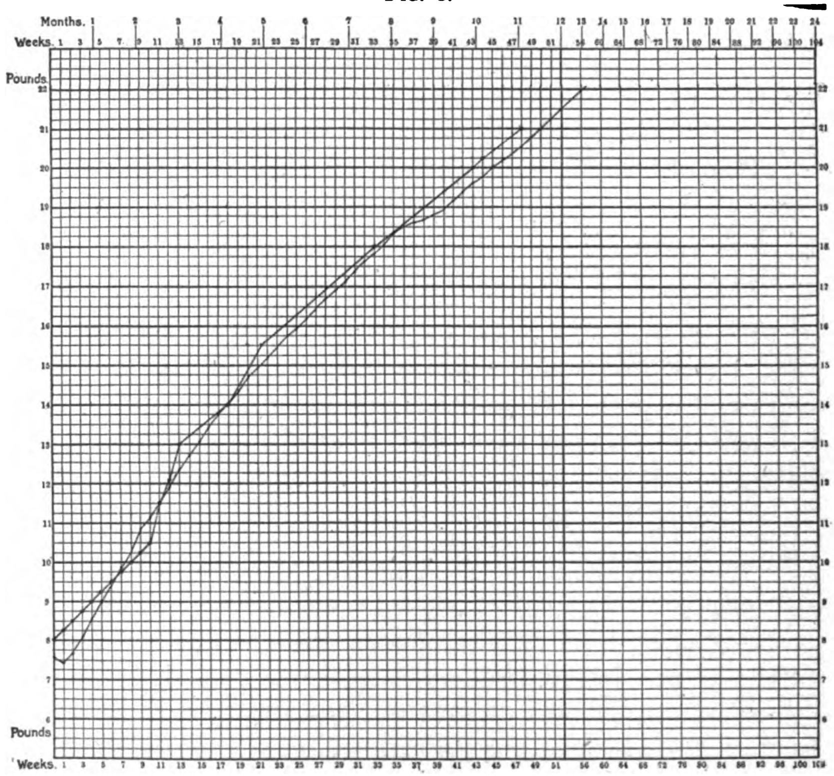
The subsequent course of feeding can briefly be sketched. The fat having reached a percentage above which it is usually inexpedient to increase (4 per cent.), the next change of formula continued the gradual increase of the proteid and sugar percentages, but slightly decreased the fat. The amount of cream was reduced to eight ounces and the milk advanced to fourteen ounces, which gave a formula of F. 3.80, P. 2.16, S. 6.09. From this the amount of milk was gradually increased to sixteen ounces, at which the formula became F. 4, P. 2.36, S. 6.31, under which satisfactory gain in weight continued. This method of regulating the formula was continued, the proportion of milk in the mixture being steadily increased and that of the cream being decreased until, as the percentages of whole milk were approached, the cream was altogether omitted. Whole milk was given at the age of fourteen and one-half months.

The history of another baby first seen at the age of ten weeks illustrates very graphically the beneficial effects of cutting down

the percentages when there are evidences of indigestion. Indeed, too slow a gain in weight may be an evidence of overfeeding as well as of underfeeding, since disturbance of digestion from the ingestion of too rich a mixture interferes with proper assimilation and normal gain in weight.

Case II. (Fig. 3).—Girl, weighing at birth eight pounds, arti-

Fig. 3.



Weight chart of Case II.

ficially fed from the first week, mixture not known. First seen at the age of ten weeks, weight ten and one-half pounds, which had been gained by a steady weekly increase of one-quarter of a pound. The last mixture given consisted of: cream three ounces, milk sixteen ounces, water twenty-two ounces, a bottle of four ounces every two hours (estimated percentages: F. 2.73, P. 1.82, S. —); and just before the baby was seen the nurse had made an increase

in the quantity of milk to eighteen ounces and increased the feeding to four and one-half ounces. This mixture, however, was partially peptonized. While gaining about a quarter of a pound a week, the child was not comfortable, suffering from distress after taking the bottle,—flatulence and colic. The stools were well digested and showed no distinct evidence of intestinal irritation. A few more weeks, however, under the forcing efforts of the nurse would undoubtedly have inaugurated a serious derangement of digestion, from which recovery would have been tedious.

The quantity of the feeding was cut down to three and one-half ounces and the following formula given tentatively:

Cream (16 per cent.)	4 ounces	F. = 2.80
Milk	12 ounces	P. = 1.56
Water	24 ounces	S. = 5.47
Sugar of milk	1½ ounces	
Partially peptonized.		

Upon this mixture a full pound was gained in the following week, and eleven ounces in the next week. An effort slightly to increase the amount of milk in this mixture was followed by hiccough and other evidences of digestive disturbance. There are two movements a day, of good color and normal consistency.

In the succeeding (thirteenth) week thirteen ounces were gained, and the weight at the end of this week was thirteen pounds, a gain of two and one-half pounds in three weeks after the formula was reduced.

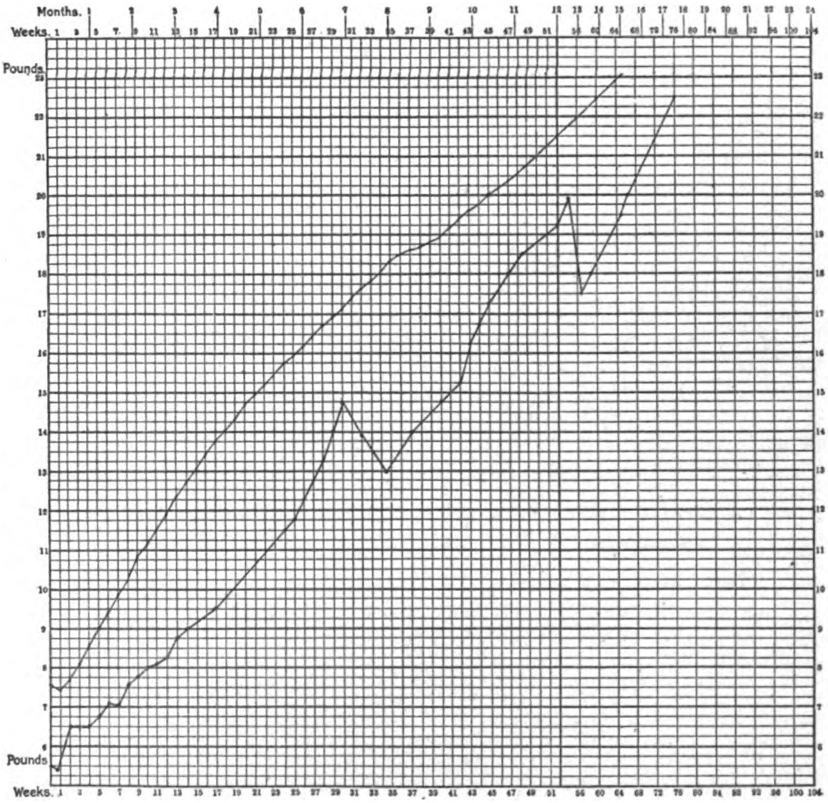
Eighteen Weeks.—Weighs fourteen pounds. Reported that the bottle has been increased to five ounces, but the baby often has hiccough and brings up a little of the food about twice in the day. Bottle reduced to four and one-half ounces and the milk rapidly to be increased to sixteen ounces, a percentage formula of F. 3.20, P. 1.96, S. 5.91.

In the next three weeks one and one-half pounds were gained, the weight being fifteen and one-half pounds at twenty-one weeks, an average gain of one-half pound a week from the time that careful feeding was begun. The subsequent progress of this child is indicated by its weight-curve. The parents lived in the country and the baby was seen only once (at the first consultation), the subsequent opportunities of supervising its diet being few and

irregular. The gain in weight, however, from a gradual concentration of its food, kept a little in advance of the normal line.

The following case is an instance of a rather weak tolerance of casein proteids, as was shown repeatedly in the later months of the first year. Notwithstanding this, a satisfactory state of nutrition was maintained upon a low-proteid mixture, which did not reach 2 per cent. of proteids until after the first year was passed.

FIG. 4.



Weight chart of Case III.

CASE III. (Fig. 4).—Female infant, weighing at birth five and one-half pounds. The mother had suffered from acute nephritis for two weeks before the birth and the child was considerably wasted. She gained at the breast for one week, when, owing to failure of the milk, partial bottle feeding was begun, and from

the end of the second week exclusive bottle feeding was necessary. The mixture suggested by the nurse consisted of

Cream (16 per cent.)	1 ounce	F. = 2.91
Milk	4 ounces	P. = 1.78
Barley-water	6 ounces	S. = 1.96

Three ounces of this mixture were taken every two hours.

During the third and fourth weeks there was no gain in weight, and only a few ounces in the fifth and sixth weeks, the weight at the end of the sixth week being seven pounds three ounces. The stools were of good color, but showed scattered white curdy masses. The baby was constantly disturbed and irritable, crying with pain soon after finishing the bottle, and having frequent regurgitation of mouthfuls of milk at no regular time of the period between feedings. Just before the first consultation at the age of six weeks the mixture had been still further concentrated by reducing the water:

Cream (16 per cent.)	1 ounce	F. = 3.20
Milk	4 ounces	P. = 1.96
Barley-water	5 ounces	S. = 2.16

Under this change there was an increase of pain and irritation of the stomach.

At the first consultation the formula was reduced to F. 3, P. 1, S. 6, of which two and one-half ounces every two hours were ordered,—a total of twenty-five ounces for the twenty-four hours:

Cream (16 per cent.)	4 ounces	F. = 3.00
Milk	2¾ ounces	P. = 1.00
Barley-water	18¼ ounces	S. = 6.00
Milk-sugar	1⅛ ounces	

After a few days the formula was increased to F. 3, P. 1.25, S. 6:

Cream (16 per cent.)	3½ ounces	F. = 3.00
Milk	4¾ ounces	P. = 1.26
Barley-water	16¾ ounces	S. = 6.00
Milk-sugar	1⅛ ounces	

For ten bottles, two and one-half ounces, every two hours.

Seven Weeks.—Baby is much more comfortable, but has a little colicky pain every afternoon from four to six P.M. Under these

conditions it was decided partially to peptonize the mixture with three teaspoonfuls of a peptonizing powder, keeping the mixture at a temperature of 105° F. for eight minutes and then rapidly raising to 170° F. and quickly cooling. No weight has been gained this week, but the general well-being of the baby is decidedly improved. The mixture is now still further enriched. Thus:

Cream (16 per cent.)	4 ounces	F. = 3.07
Milk	5½ ounces	P. = 1.30
Barley-water	18½ ounces	S. = 6.00
Milk-sugar	1¼ ounces	
Partially peptonized.		

Eight Weeks.—Has gained five ounces, weighing seven pounds eight ounces. Does not seem satisfied with her feeding. The quantity of milk in the mixture is to be gradually increased by two fluidrachms daily till the formula becomes

Cream (16 per cent.)	4 ounces	F. = 3.14
Milk	6 ounces	P. = 1.37
Barley-water	18 ounces	S. = 6.00
Milk-sugar	1¼ ounces	
Partially peptonized.		

Nine Weeks.—Has gained four ounces, weighing seven and three-quarters pounds. Quantity to be increased to three ounces at a feeding, eight or nine bottles a day.

Ten Weeks.—Has gained four ounces, weighing eight pounds. Passages are of good color and well digested, two or three daily.

Eleven Weeks.—Has gained only two ounces.

Twelve Weeks.—Has gained two ounces, weighing eight and one-quarter pounds. Formula is now

Cream (16 per cent.)	4 ounces	F. = 3.23
Milk	6⅝ ounces	P. = 1.46
Barley-water	17⅜ ounces	S. = 6.07
Milk-sugar	1¼ ounces	

This is at once increased to

Cream (16 per cent.)	4¼ ounces	F. = 3.43
Milk	7 ounces	P. = 1.55
Barley-water	16¾ ounces	S. = 6.17
Milk-sugar	1¼ ounces	
Partially peptonized.		

Thirteen Weeks.—Has gained eight ounces, weighing eight and three-quarters pounds.

Fourteen Weeks.—Has gained four ounces, weighing nine pounds. About to remove to the country for the summer. The milk here was analyzed and found to contain 4 F. and 3.50 P. The formula was therefore changed to

Cream (gravity = 16 per cent.)	3¼ ounces	F. = 3.43
Milk	10 ounces	P. = 1.63
Barley-water	14½ ounces	S. = 6.53
Milk-sugar	1¼ ounces	
Partially peptonized.		

Seventeen Weeks.—Weighs nine and one-half pounds. To increase feeding to four ounces and change formula to

Cream (gravity = 16 per cent.)	4 ounces	F. = 3.50
Milk	12 ounces	P. = 1.71
Barley-water	16 ounces	S. = 6.52
Milk-sugar	1⅜ ounces	
Partially peptonized.		

Twenty-four Weeks.—Weighs eleven and one-half pounds. Formula changed to

Cream	3½ ounces	F. = 3.22
Milk	15 ounces	P. = 1.77
Barley-water	17½ ounces	S. = 6.40
Milk-sugar	1½ ounces	
Partially peptonized.		

Seven bottles, four and one-half ounces, each two and one-half hours. Bowels are regularly moved once or twice a day.

Twenty-six Weeks.—Weighs twelve and one-quarter pounds, nearly a half-pound of which was gained in the last week.

Twenty-eight Weeks.—Weighs thirteen and one-quarter pounds. It has been found that any further increase in the quantity of milk in the formula causes vomiting. To increase feeding to five ounces and make interval three hours.

Twenty-nine Weeks.—Increase in quantity is well borne; has gained three-quarters of a pound in the week, weighing fourteen pounds.

Thirty Weeks.—Has gained three-quarters of a pound, weighing fourteen and three-quarters pounds.

The family then returned to town from the country, and feeding with the city laboratory milk was begun. Owing to the delicate digestion, the first formula ordered in town was made to contain an ounce less of milk, giving a slightly lower percentage of fat than would have resulted from a continuance of the quantities of milk used in the country, though, on account of the higher proteid percentage of the city milk, the actual proteid percentage was apparently somewhat increased:

Cream (16 per cent.)	3½ ounces	F. = 3.10
Milk	14 ounces	P. = 1.90
Barley-water	18½ ounces	S. = 6.54
Milk-sugar	1⅜ ounces	

Partially peptonized.

This mixture agreed well, but seemed to be as strong in proteids as the baby could digest. At this time progress was suddenly checked by a severe attack of influenza, which developed a few days after reaching home. During this attack the food mixture was prepared in the usual way but was diluted, at first with an equal part of barley-water. After subsidence of the fever the quantity of diluent was gradually decreased, according to tolerance, until the regular mixture and the usual quantity for a feeding was again reached. This return to the regular strength of mixture was made quite slowly, since it was found that the child's digestion had been greatly weakened, and too rapid a change in the dilution was followed by evidences of indigestion. At the age of thirty-four weeks the weight had declined to thirteen pounds, but from this time onward the gain in weight was rapid. From the thirty-fifth to the fortieth week the weight rose from thirteen pounds to fourteen and three-quarters pounds, the point it had reached at the beginning of the illness. Repeated efforts were made during this interval to increase the quantity of milk in the mixture, but it was found that an increase in the proteid percentage from 1.90 to 1.93, which was obtained by adding only two fluidrachms more milk to the mixture, produced curds and mucus in the stools. The quantity at a feeding was increased to five and one-half ounces, the additional half-ounce being barley-water, since it was found that a larger proportion of the milk mixture produced flatulence and discomfort.

Forty-three Weeks.—Has just begun to take five and one-half

ounces of mixture undiluted every three hours. Weight has increased to sixteen and one-quarter pounds. To increase bottle to six ounces.

Forty-five Weeks.—Has gained one pound in the two past weeks, weighing seventeen and one-quarter pounds. The quantity of milk in the mixture to be gradually increased to fourteen and one-half ounces, then to fifteen ounces.

Forty-seven Weeks.—Weighs eighteen pounds. Has cut first tooth.

Forty-nine Weeks.—The increase to fifteen ounces of milk is not well borne, the feeding being followed by distress, fretfulness, hiccough, and regurgitation. Milk reduced again to fourteen and one-half ounces. Weighs eighteen and one-half pounds.

In this case, as will be noticed in the chart (Fig. 4), the weight was rapidly nearing the normal line just before the attack of illness about the thirtieth week. The very satisfactory gains of the preceding two months were all made upon a mixture containing only 1.77 per cent. of proteids, with a feeding quantity considerably below the average for the age. Had there been no intercurrent disease it is quite probable that the proteid percentage could have been raised above 2 before the end of the first year. The rapid gain of weight, however, upon a proteid mixture of 1.90 per cent. is quite noteworthy.

Mixed Breast and Bottle Feeding.—The importance of weighing the baby at regular intervals is never more clearly emphasized than in the case of breast-fed infants, whose daily ration of food, both as to its quantity and its percentages, cannot be controlled or even definitely estimated. And at the present day, when normal breast-feeding is rather the exception among a large proportion of mothers of the better classes of society, it is nothing unusual to be confronted with the problems of early weaning during the first six months of the infant's life. Many mothers who begin with an abundant supply of nourishment for their offspring soon realize to their bitter disappointment that their milk is failing quite early in the period of lactation, and usually all methods of artificial stimulation of the secretion fail to retard the premature cessation of this function. Under these conditions a break in the upward trend of the weight-curve, in conjunction with the physical signs of unsatisfactory nutrition in the nursling, offers the surest indica-

tion of failure of the maternal milk supply, and no time should be lost in submitting the milk to careful analysis by the methods already described. The sample should be taken from the middle of a nursing, since the first portion of the milk drawn by the baby is richer, and the last portion is poorer, than the general average of the secretion. Marked deterioration from the standard fixed by the average analysis of breast-milk, if it cannot be quickly modified by appropriate treatment of the mother, calls for a partial or complete substitution of an artificial mixture.

If the failure be one of quantity rather than of quality, the breast-feeding may be supplemented for a time by the use of one, two, or three bottles daily to alternate with the nursing, during the day, and the breast alone kept for the one or two night feedings. When, however, the baby is restless and wakeful at night, and cannot be quieted unless constantly lying at the breast, it is useless to waste further time in a futile attempt to keep up maternal feeding.

It is always a good rule, when practicable, to have an analysis of the mother's milk made early in the period of lactation, after the establishment of equilibrium in the secretion, so as to have a guide as to the percentages of fat, proteids, and sugar upon which this particular infant thrives satisfactorily. Should any necessity for early weaning arise, we have the safest formula upon which a substitute mixture can be compounded. Lacking this, the ordinary averages appropriate to the age of the baby may be taken as a guide and a corresponding combination be cautiously tried.

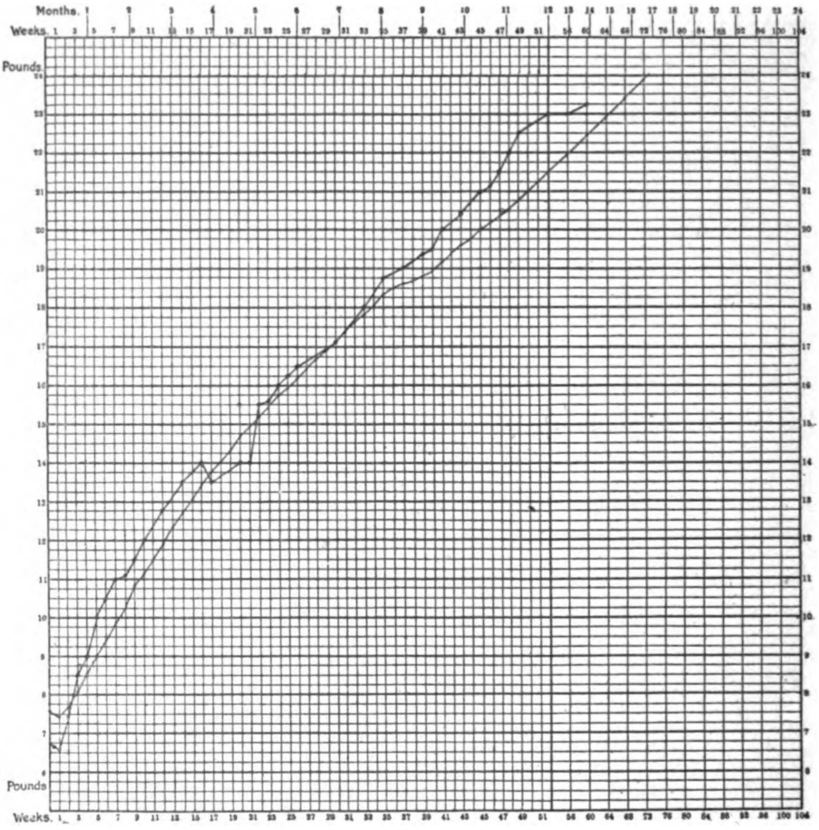
It will often be found possible to convince a doubting mother that her milk has become unfitted for nourishing her baby, by demonstrating the improvement that follows the substitution of one, two, or three bottles a day, and after this the change to an exclusively artificial diet will be accepted without a murmur.

The following case illustrates the effect of deterioration of the breast-milk produced by the early re-establishment of menstruation, and the immediate improvement shown after substitution of at first one, and then two, bottles for a corresponding number of the regular nursings.

Case IV. (Fig. 5).—Girl, weighing at birth six and three-quarters pounds, was nursed entirely at the breast until sixteen weeks old, when the weight reached fourteen pounds. At this time

the mother began to menstruate, and the effect upon the nutritive quality of her milk is shown by the loss of half a pound in a week, which was followed by slow recovery up to the previous weight by the end of the four weeks, when menstruation again occurred,

FIG. 5.



Weight chart of Case IV.

and was attended by a stand-still in the baby's weight for another week.

One bottle of four ounces in the middle of the day was now ordered, of a formula

Fat	3.55	Cream	$1\frac{3}{4}$ ounces.
Proteids.	1.83	Milk	4 ounces.
Sugar	6.00	Milk-sugar	$\frac{1}{2}$ ounce.
		Water.	$9\frac{1}{4}$ ounces.

The improvement was immediate, one and one-half pounds being gained in the following week. The number of bottles was increased to two and then three a day, the breast-feeding being continued at night and for the remaining day feedings, until the ninth month, when weaning was readily accomplished. At the end of the seventh month the formula was gradually increased in the percentages, and whole milk feeding was reached about the fourteenth month.

Feeding after Early Weaning.—Early weaning may be necessitated by the occurrence of a serious infectious disease in the mother, such as variola, scarlatina, diphtheria, or erysipelas, or of suppurative inflammation of the breast; by the incidence of pregnancy; by the re-establishment of menstruation, which, if it recur regularly, sooner or later causes deterioration of the milk; by the onset of rachitic symptoms or of other nutritional evidences of an unsuitable quality of the breast-milk; or, finally, by the refusal of the baby to accept mixed feeding as long as the breast is regularly presented. When the child has had the benefit of three or four months of satisfactory breast-feeding, the sudden change to an exclusive artificial diet need give rise to no apprehension, except in the very hottest weather of summer under extremely unfavorable conditions for obtaining a fresh, clean supply of good cows' milk.

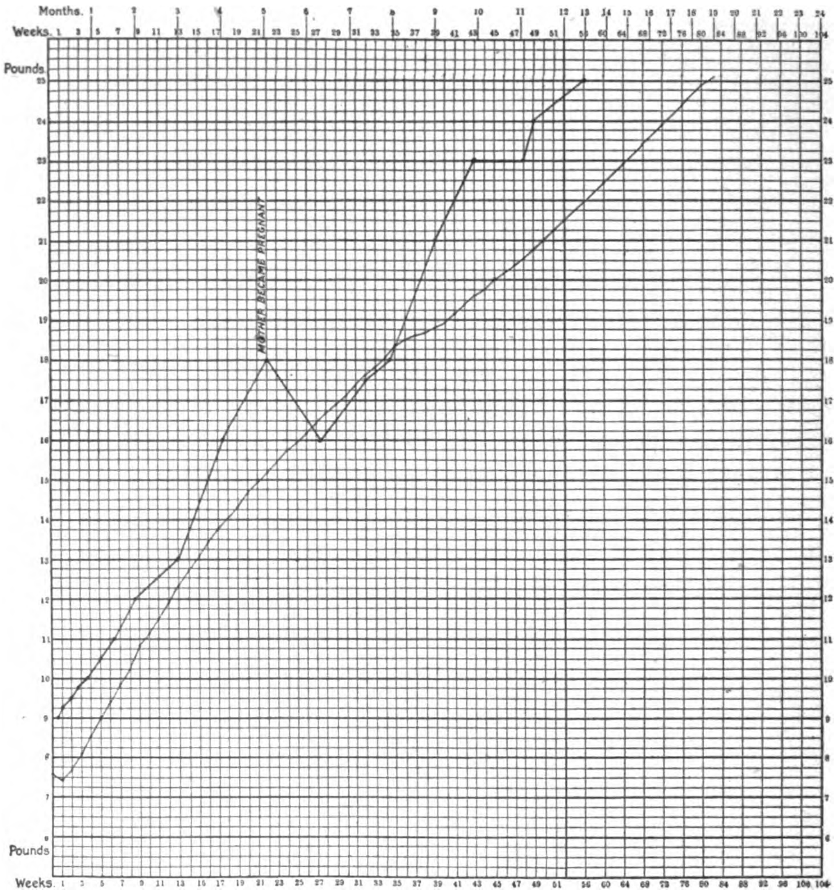
If a preliminary analysis of the mother's milk has not been already made, the initial formula should be chosen slightly lower in proteids and fat than would be given at the same age to a baby artificially fed from birth.

The following case illustrates the rapid loss of weight in a perfectly healthy breast-fed baby observed after the occurrence of pregnancy in the mother at the end of the twenty-second week. The loss in weight in the nursling began almost from the moment of impregnation, though the condition was not positively recognized for five weeks, during which a steady decline in the baby's weight was recorded.

CASE V. (Fig. 6).—Boy, weighing at birth nine pounds. Was nursed entirely at the breast, making steady normal gain in weight until the end of the twenty-second week, when he weighed eighteen pounds. At this time, as calculated from the date of birth of the second child, the mother became pregnant. The baby immedi-

ately began to lose weight, though the mother was not positively aware of her condition till five weeks later, when the baby's weight

FIG. 6.



Weight chart of Case V.

had fallen to sixteen pounds. The infant was at once weaned and the following formula was ordered:

Fat	3.08	Cream	½ ounce.
Proteids	2.12	Milk	3 ounces.
Sugar	6.20	Water	2 ounces.
		Milk-sugar	¼ ounce.

For one bottle of six and one-half ounces, five bottles a day.

Under this mixture the lost weight was promptly regained. Since the combination was well borne and the gain in weight somewhat slower than before weaning, the concentration of the mixture was rapidly increased and whole-milk feeding was reached soon after the beginning of the ninth month.

This was an unusually robust child. The advance to whole-milk feeding at so early a period before the end of the year is exceptional and would not be tolerated by many quite normally developed children.

Feeding in Acute Diseases during Infancy.—During the course of many of the acute general infections that may befall the hand-fed infant in its first year, some changes in the ordinary bottle mixture will become necessary. Since the integrity of digestion is distinctly impaired during the active evolution of an infectious disease, a reduction in the percentages of both fats and proteids should be made at the beginning of treatment. This may be accomplished by a complete alteration of the formula to suit the individual requirements of the case, or, as the writer prefers, by simple dilution of the baby's usual mixture. The latter plan has the advantage of not confusing the mother with new formulæ and of enabling her after convalescence is established gradually to return to the original strength of the mixture without the use of numerous intermediate formulæ. According to this plan, the mother is directed to make up the usual mixture (or a portion of it, if so much shall not be needed) and then to dilute two or three parts of the mixture with one or two parts of plain water or barley-water to make a bottle of about one-half or two-thirds of the usual quantity given at a feeding. The resulting percentages will, of course, depend upon the degree of dilution, and can be calculated by multiplying the percentages of the original formula by the number of parts of the mixture and dividing by the sum of the number of parts of the mixture and of the diluent. A dilution made by taking two parts of the mixture and one of water would give percentages which are two-thirds of those of the mixture; by taking three parts of the mixture and one of water, three-fourths of the original percentages; and by taking four parts of the mixture and one of water, four-fifths of the original percentages would be obtained.

The return to the usual percentages during convalescence should be more or less rapid according to our knowledge of the infant's

digestive peculiarities, and depending upon its tolerance of gradual concentration of the dilution. A child like that instanced in Case III. would need a greater dilution of the mixture during its illness and a much slower return to its usual percentages during convalescence than a robust baby like the one described in Case V. In the former case, during the height of an attack of pneumonia, for instance, a half-and-half dilution would be none too weak, and the return to the original formula might require a full month or longer; while the latter baby, under similar conditions, would easily digest a dilution of three parts of the mixture with one part of water, and could resume the full strength in a very few days after the crisis of the disease.

INDEX TO VOLUME III.

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A.

B.

C.

D.

E.

F.

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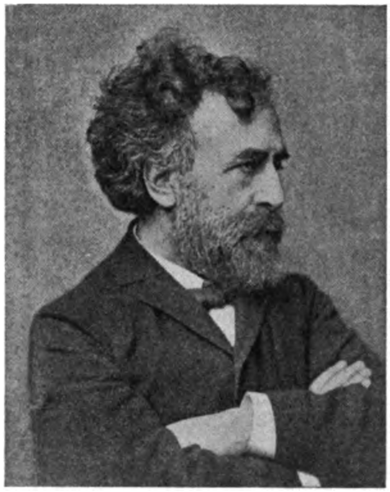

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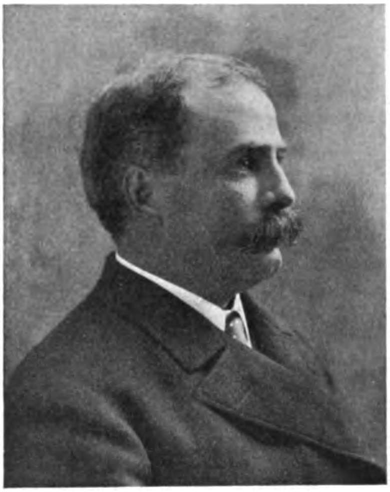

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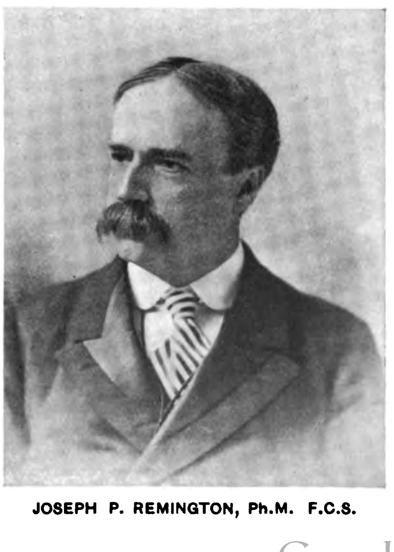

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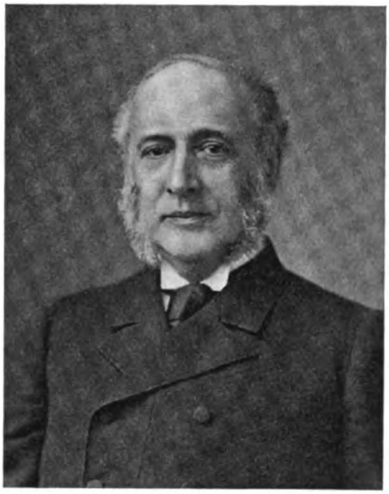

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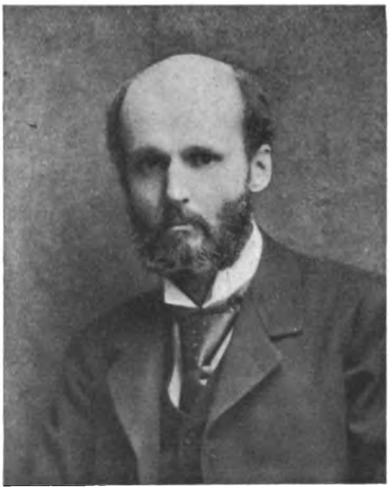

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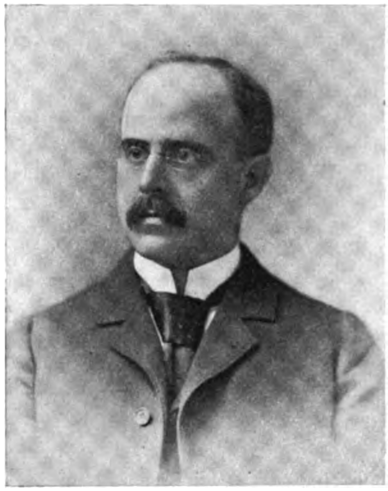

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